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TABLE OF RELATIVE HUMIDITY.

By EDWARD ERNEST DYMOND, F.M.S.

[Read November 17th, 1880.]

THE following Table was prepared with a view to facilitate the calculation of the degree of Relative Humidity, as shown by the Hygrometrical Tables in common use. With this object, the figures required have been extracted and arranged by themselves, and their number has been diminished as much as possible.

In thus bringing these figures together two points have been brought prominently into view. First, the extreme irregularity of variations in the degree of relative humidity for equal increments of temperature and equal differences between the dry and wet bulb readings at air temperatures below 86°; and, secondly, that at any given difference, from 2° to 7° inclusive, the degree of relative humidity at an air temperature of 42° is said in the Tables to be greater than the degree of relative humidity for the same difference at an air temperature of 44°.

In the latter case the figures have simply been transposed; in the former they have been left as stated in the Tables, and seem to furnish further evidence that at low temperatures the results deduced from observations of Mason's hygrometer are not to be relied upon.

The method of using the Table is as follows:—Look for the nearest degree of air temperature in the first column. Find the difference between the dry and wet bulb thermometers, and in the column at the head of which is placed the same or nearest difference, on the line beginning with the nearest dry bulb reading, will be found the degree of relative humidity.

| Dry Bulb Reading | Difference between Readings of Dry and Wet Bulbs. | | |

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MAP OF
SOUTH AFRICA
SHOWING THE POSITION OF
THE RAINFALL STATIONS.
TRANSVAAL
ZULU LAND
NATAL
BASUTO LAND
KAFFRARIA
ORANGE FREE STATE
GRIQUALAND WEST
Pietermaritzburg
Ottawa
Durban
Greytown
Mervebank
Aliwal North
Queenstown
King Williamstown
Graham's Town
Port Elizabeth
Colesberg
Graaff Reinet
Somerset East
Uitenhage
Bradfontein
Lower Nel's Poort
Cambers Kraal
Amalienstein
Mossel Bay
Clanwilliam
Cape Post
Cape Observatory
Worcester
Somerset West
Wynberg
Cape Town
Town House
Rondebosch
Sea Point
Bishopscourt
Simonstown
22° Long. East of 24° Greenwich.
Malby & Sons, Lith.

Thus dry bulb, 55°·5; wet, 51°·8.

Difference 8°·7; in the column headed 8°·8 and in the line 56° will be found 76, the degree of relative humidity.

Sometimes it may be desirable to interpolate a figure thus: Dry, 48°; wet, 43°·5; difference, 4°·5. In the column headed 4°·4, at a temperature 48°, the relative humidity is stated to be 71, and in the column headed 4°·6 it is stated to be 69, so that for the difference of 4°·5 the relative humidity may be stated as 70; but cases such as these occur but rarely, except when the difference is very small, and a very slight amount of practice in using the Table suffices to enable the computer rapidly and accurately to ascertain the relative humidity at all temperatures commonly met with in England at 9 a.m.

DISCUSSION.

Mr. HOPKINSON submitted a Table he had prepared for calculating the Relative Humidity from the temperature of the air and dryness (*i.e.* difference between dry bulb and dew-point). In working it out from Mr. Glaisher's Table of the Elastic Force of Aqueous Vapour he had found the same difficulty as Mr. Dymond had in the irregularity of the figures. He had, therefore, slightly altered them, so that they ran more evenly, thus making the Table not only more harmonious, but also, he believed, more correct.

Mr. GASTER, after remarking on the advantages of the Table, pointed out that serious doubts were beginning to be entertained as to the value of hygrometric values obtained from observations made with a dry and wet bulb hygrometer. In comparisons which he had made between the indications of a Dines's Hygrometer and those of a Mason's (dry and wet bulb) Hygrometer, he had found the former give dew-point values as much as 12° lower than the latter; and he believed that on one occasion Mr. Dines had found as much as 19° between the indications of the two instruments. These experiments were made with scrupulously clean wet bulb mountings; and when it is remembered that observers are often less careful about such matters than they should be, it appeared to him (Mr. Gaster) that dry and wet bulb readings are of little value hygrometrically.

Mr. DYMOND said that he had mostly taken the figures from the published tables, but that some gaps had been filled up, and some doubtful figures verified by calculation from the Vapour Tension Tables.

The PRESIDENT (Mr. Symons) said that as regarded the accuracy of the tables at low temperatures, there was some years ago published in the 'Proceedings of the Royal Society' a Paper by Capt. Noble, which contained the results of some comparisons made between Regnault's Hygrometer and the Dry and Wet bulb Thermometer in Canada. He believed that a series of experiments, with different forms of hygrometers, was being carried on at Cambridge, under the supervision of the Meteorological Council; the results of which would be of the very highest importance.

RAINFALL IN SOUTH AFRICA.

By JOHN G. GAMBLE, M.A., M.INST.C.E., F.M.S. (Plate I.)

[Read November 17th, 1880.]

UNTIL quite recently there have been very few meteorological stations in South Africa, there has been no inspection of those stations, and, strictly speaking, the only perfectly trustworthy record embracing any considerable number of years is that kept at the Royal Observatory, near Cape Town.

The services of all the observers in the Cape Colony are gratuitous, and in consequence the records are frequently intermittent, and not always so trustworthy as might be desired.

There has indeed been a Meteorological Commission appointed by the Government of the Cape Colony, but the energy of this Commission has been somewhat spasmodic. During the years 1861, 1862, 1863, 1864, 1865, 1866, 1867 and 1868, the returns from a few observatories were printed. For some reason or other, printing was discontinued in 1869 ; and between 1869 and the latter end of 1875 very few records were kept. Towards the end of 1875 a revival took place, and since then a yearly report has been published by the Meteorological Commission giving the observations from between ten and twenty stations.

The author, finding in his professional work a great want of records of rainfall, suggested to the Colonial Government that rain gauges, at any rate, might be established at the various seats of magistracy, and that they should be observed regularly by the gaoler, who, from the nature of his occupation, cannot leave his post, or who, if he does, must provide a competent substitute. The Colonial Government approved of this suggestion, and at present nearly every seat of magistracy in the Colony is supplied with a gauge. The magistrate is instructed that it is part of his duty to see that the gaoler or other observer reads the gauge carefully, records the readings accurately, and sends up the returns regularly. Some railway stations are also supplied with gauges, and the station-master has orders to keep the records.

There are ninety-five stations in the colony where observations were taken during 1879, and at seventy-one of those a complete year was observed. It may be fairly hoped that a much larger number of complete year observations will be available in future.

Besides the 95 stations in the Cape Colony, one observer is sending records from Griqualand West and five from the Orange Free State, so that there are more than one hundred observers sending in records to the Meteorological Commission of the Cape Colony. Observations are also taken in Natal, and the observations from three stations have been kindly furnished to the author, but possibly there are more.

Some returns have also been received from a somewhat distant station, Molepoli, in Bechuanaland, but it can scarcely be hoped that any long record can be kept up at such a distant and, at present, uncivilised place.

The accompanying Table gives the monthly means from all stations in South Africa from which a record of five years or upwards could be obtained. The number of years obtainable in each case is given in the second column. It will be seen that twenty-five stations have been obtained in the Colony, and five in Natal (Plate I.) The annual total is not always an exact sum of the monthly means, as it is a mean of the complete years, while the monthly means embrace incomplete years, so long as the month itself is complete. The total rainfall for 1879 is also given in the last column.

The author has given the approximate heights of most of the stations above sea level. Where the stations are close to a line of railway, the heights

Stations.	No. of years which the is taken	Approximate Height above Sea-Level	South Latitude.	East Longitude.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	Rainfall for
		Ft.	° ′	° ′	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Cape Peninsula.—Royal Observatory	39	37	33 56	18 29	0·67	0·65	0·87	1·79	3·94	4·57	3·43	3·37	2·11	1·58	1·14	0·77	24·89	18·74
Capetown—Town House	16	circa 50	33 55	18 25	0·41	0·73	0·82	1·63	4·37	5·14	4·20	3·79	1·83	1·78	1·09	1·03	26·77	22·20
Sea Point	7	c. 100	33 58	18 23	0·33	1·00	0·57	1·56	2·53	4·10	3·28	2·07	1·48	2·47	0·81	0·45	20·65	..
Bishopscourt	9	c. 300	33 59	18 27	0·95	1·59	1·30	3·02	8·42	10·07	7·00	7·34	5·21	3·86	2·32	2·47	53·85	44·97
Wynberg	14	c. 200	34 1	18 28	0·52	1·06	0·59	2·29	6·56	8·36	7·59	6·54	4·10	2·92	2·04	0·84	42·65	34·62
Simonstown	7	?	34 12	18 26	0·73	0·75	1·21	1·79	3·87	4·34	4·08	3·24	1·97	2·54	1·31	1·13	29·20	..
South West.—Somerset West	5	120	34 5	18 52	0·66	0·58	1·04	1·52	2·63	4·74	4·29	2·66	2·59	2·53	1·31	0·52	25·01	22·14
Worcester	13	780	33 40	19 27	0·07	0·92	0·40	0·93	2·19	2·37	2·48	1·40	1·31	1·81	0·72	0·23	14·29	..
West Coast.—Groote Post	14	? 300	33 28	18 24	0·51	0·52	0·57	1·12	3·15	3·18	3·13	2·45	1·54	1·36	0·78	0·65	19·01	13·19
Clanwilliam	8	?	32 10	18 53	0·14	0·20	0·31	0·54	1·86	1·56	2·21	1·04	0·44	0·81	0·49	0·29	10·11	..
South Coast.—Mossel Bay	6	? 100	34 11	22 9	0·46	2·69	1·83	0·87	1·76	0·81	2·11	1·49	1·74	1·63	0·94	0·39	16·72	14·81
Port Elizabeth	13	180	33 57	25 37	0·85	1·65	1·92	1·73	2·17	1·98	2·34	1·95	2·11	2·71	2·38	1·79	24·36	19·99
Uitenhage	17	c. 200	33 47	25 24	0·74	1·87	1·23	1·08	1·47	0·44	0·99	1·29	1·51	2·28	1·79	1·03	15·36	17·90
Southern Karroo.—Amalienstein	13	c. 3,000	33 27	21 24	0·66	1·55	1·67	1·33	2·49	0·92	1·50	1·58	0·81	1·37	1·94	0·56	16·38	13·17
West Central Karroo.—Camfers Kraal	12	? 2,900	32 17	23 3	0·56	1·25	1·51	0·84	0·85	0·39	0·30	0·43	0·38	0·68	1·03	0·71	8·93	8·94
Lower Nel's Poort	6	? 3,000	32 14	23 4	1·11	1·80	2·47	1·43	0·60	0·13	0·42	0·32	0·84	0·77	0·73	0·43	10·06	11·66
East Central Karroo.—Graaff Reinet	19	2,500	32 16	24 34	1·39	2·28	1·68	1·27	0·99	0·36	0·73	0·77	0·79	1·29	1·59	1·46	14·59	13·72
Goliaad's Kraal	16	c. 3,500	32 8	24 40	1·16	2·30	1·77	1·26	0·89	0·28	0·59	0·82	0·63	1·35	1·42	1·32	13·79	16·07
Wellwood	5	c. 4,000	32 5	24 45	1·55	1·92	2·21	0·99	0·86	0·68	0·66	0·46	0·67	0·60	1·24	0·73	12·57	13·89
Somerset East	9	c. 2,500	32 44	25 35	1·74	2·37	3·04	1·45	1·59	0·27	0·77	0·70	1·06	2·21	1·85	1·99	19·04	26·42
Northern Karroo.—Brakfontein	7	? 4,000	31 40	23 10	1·46	1·46	2·03	0·56	1·02	0·37	0·33	0·11	0·49	0·44	1·32	0·83	10·67	11·24
South East.—Grahamstown	18	1,800	33 20	26 33	2·23	3·08	2·98	2·38	1·74	1·04	1·67	1·86	2·59	2·35	3·34	2·98	28·73	29·91
King Williamstown	10	2,100	32 51	27 37	2·49	4·08	3·23	2·15	1·81	0·46	1·71	1·20	1·42	2·43	2·63	3·33	28·23	24·08
North East.—Queenstown	8	3,540	31 53	26 51	2·85	3·60	3·62	1·80	0·75	0·48	0·60	0·36	0·62	0·92	2·31	3·08	22·42	21·58
Aliwal North	14	4,400	30 43	25 40	3·73	5·11	3·14	1·90	1·24	0·69	0·57	0·45	0·67	1·63	2·68	2·83	24·86	22·86
Natal.—Durban	7	130	29 50	31 0	5·02	5·82	5·48	2·45	1·15	1·55	1·69	1·37	2·86	3·26	6·87	5·52	42·05	44·46
Ottawa	10	300	29 38	31 7	4·14	4·32	4·92	4·04	1·16	0·99	1·62	1·24	2·04	3·09	5·78	5·44	38·98	41·13
Pietermaritzburg	10	2,100	29 36	30 20	3·97	4·45	3·46	1·58	0·75	0·23	0·25	1·01	1·41	3·29	4·91	4·87	30·35	42·29
Gardenscliffe	13	2,270	29 38	30 30	5·08	4·87	4·36	2·93	0·67	0·11	0·58	1·47	1·78	3·24	5·52	5·19	35·81	..
Merebank	9	30	29 55	30 55	2·59	5·32	6·92	5·50	1·27	1·05	1·07	3·39	2·14	4·62	5·46	4·87	44·21	..

are accurate, being given by spirit-levelling; but in other cases the heights are given by barometric readings. Some of these are tolerably accurate, being calculated from a considerable number of observations with mercurial barometers, though even in this case there is some uncertainty as to whether the sea-level given by the nearest coast observatory is the true reduced sea-level for the place itself. In other cases the heights are less trustworthy, being obtained only from a few readings with an aneroid; these are marked with a query.

The latitude and longitude of each station are also given; these are in most cases only approximate, being scaled from the last map of South Africa published by the Surveyor-General's department for the Cape Colony.

The Cape peninsula, the South-West and the West coast have winter rains with a dry summer, characteristics of what is called the subtropical region, the rains coming with the NW wind or anti-trade: while Natal, Aliwal North, and, in a less degree, Queenstown have the tropical features of a wet summer and dry winter.

On the south coast the rainfall appears to be more equally distributed throughout the year, though there seems to be an October maximum at Port Elizabeth and Uitenhage.

In the Central and Northern Karroo the maximum of the very scanty rainfall occurs in February and March. These rains generally fall in thunderstorms; each storm seems to come from a westerly direction, but it is a more or less well-ascertained fact that these rains do not fall up country until the south-easters have set in on the south and south-west coasts.

In the south-east of the Colony the transition towards tropical features may be noticed, both Grahamstown and King-Williamstown showing a winter minimum in June.

A point that may be noticed is the heavy rainfall at Bishopscourt and Wynberg, compared with the moderate rainfall at the Royal Observatory, only some five miles distant. Bishopscourt and Wynberg both lie on the leeward side of Table Mountain when the NW or rain-bearing wind of winter is blowing. Bishopscourt lies close under Table Mountain; and Wynberg lies on a spur which runs out from Table Mountain and forms the water-parting between Table Bay and False Bay, between the Atlantic and the Indian Ocean. The valley in which Bishopscourt is situated, as well as Wynberg Hill, is thickly wooded; possibly this may have something to do with the heavy rainfall: or perhaps the rain-bearing north-west wind may here mingle with a colder eddy from the south.

One curious fact, that requires explanation, is, that at most of the eastern stations, January is a drier month than February, and generally is drier than December also.

A somewhat analogous fact is noticed in the curve for the Royal Observatory. The Observatory means are the result of thirty-nine years' observation, and, therefore, it might be expected that peculiarities owing to special years would be eliminated. In the Observatory curve a rather remarkable hesitation is noticed in the month of July, which month is drier than would be given by

a regular curve. This feature is noticeable at Bishopscourt and at Capetown, but not at Wynberg, Seapoint or Simonstown. The observations at these other stations, however, do not embrace a sufficient number of years to test this peculiarity. It has been suggested that, as July is the month of minimum temperature, the area of maximum rainfall, which was over the Cape in June, penetrates further north in July, and then returns over the Cape again in August. The Clanwilliam records lend some colour to this, as they show a July maximum, and Clanwilliam is nearly due north of Capetown.

Another step in advance was made in 1879. The author had previously endeavoured to impress on the Meteorological Commission the great necessity for systematic inspection. Mr. David Gill, at present H.M. Astronomer at the Cape, arrived in the Colony in 1879; and by his valuable help the Government was induced to propose to Parliament, and Parliament to grant a sum of money for inspection. The Secretary to the Commission has since visited nearly all the stations in the Colony, and the result has abundantly justified the urgency claimed for it. The mercury in the siphon barometers was generally dirty, very few of the wet bulb thermometers were properly kept, the minimum thermometers seemed generally untrustworthy, and Robinson's anemometer rarely understood. One observer kept the rain-gauge in a cupboard, and only put it out when rain threatened. The Secretary's report will, however, be printed in the Reports of the Commission for 1879 and 1880, the former of which has for some time been in the printer's hands and may be expected shortly. The author hopes to be able to present a copy to the Society at an early date.

DISCUSSION.

Mr. SCOTT remarked that in the 'Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie,' Vol. XIII. p. 417, there was a paper on the climate of the Herero Land, near Walfisch Bay, which, he believed, was the same as the Damara Land. The author was Baron v. Danckelmann, and he stated that the wet wind was the E or land wind, while the dry wind was the W or sea wind. This was very interesting, and a confirmation of it was desirable. The Baron maintained that the dryness of the coast line was due to the presence of a cold current outside, and cited Peru as a similar instance.

The PRESIDENT (Mr. Symons) thought that the land wind at Walfisch Bay being a wet wind might be accounted for by the fact that it came from the hot interior of the country, and on reaching the coast and coming in contact with the cooler air from the sea, the vapour in it would be condensed. Mr. Gamble, two years ago, wrote a Paper on the Rainfall of Cape Colony, but there were then only 30 stations. He (Mr. Symons) had taken out the annual falls at some of these stations and plotted them on a map with the following result:—Natal Coast, 44 ins.; Maritzburg, 30 ins.; Central Plains, 25 ins.; Cape Town, 30 ins. and 35 ins.; West Coast and Namaqua Land, 8 or 9 ins. With regard to the seasonal oscillation of the rain north and south, this was borne out by a rainfall map of Africa by Keith Johnston, which was made from travellers' notes of rainfall.* Mr. Gamble's method of taking the averages, although the usual one, was inferior to that whereby the means of short periods, which might be unusually wet or unusually dry, were reduced proportionally to the nearest record running over a number of years. By this plan even the observations of two or three years may be reduced to close approximation to true mean values. He was very glad that the subject was being so efficiently supervised.

* 'Africa,' by Keith Johnston.—London, Stanford, 1878.

Col. CROSSMAN said that the heavy rains and thunderstorms in Griqualand West came down during the months of December, January and February. He thought the Government could not have done a better thing than to ask Mr. Gamble to report upon the works required for a proper supply of water in the Cape Colony.

THE METEOROLOGY OF MACKAY, QUEENSLAND. By HENRY LING ROTH, F.M.S.

[Read November 17th, 1880.]

WHILST collecting notes for my 'Report on the Sugar Industry,' I took a flying visit to Messrs. Rawson's cattle station, the "Hollow," and found that these gentlemen had for the last four years been taking meteorological observations, but owing to press of work had been unable to reduce any results. I therefore set to and reduced their observations to the accompanying Tables (p. 9). The observations extend from January 1st, 1876, to December 31st, 1879.

The town of Mackay is situated in lat. 21° 10′ S, long. 149° 5′ E, five miles from the coast. The "Hollow" is about 20 miles due west of the town on the right bank of the Pioneer River, some 200 feet above sea-level.

The instruments are all of Pastorelli's make, and were verified at Greenwich before their departure: since their arrival they have been frequently verified. The observations were made daily at 8 a.m. The rain gauge has a funnel 8 inches in diameter, and the rim is 3 feet 1 inch above the ground. The bulbs of the thermometers are 3 feet 9 inches above the ground.

DISCUSSION.

Mr. BONWICK remarked that Mackay was the celebrated sugar-growing district of Queensland, and the sugar port bore the same name. The soil was unsurpassed for the special culture, and the climatic conditions were most favourable. But he desired to supplement the facts of the Paper by information relative to contiguous places, as the rainfall question was so important to the industry. The wet month on that coast is March. While, in 1878, Mackay, lat. 21°, showed 41¼ ins. of the annual 86 ins.; Bowen Port, lat. 20°, had 25½ ins.; Townsville, 19°, had 13½ ins.; Herbert, 18½°, had 26½ ins.; Cardwell, another great sugar station, 18°, had 37¼ ins.; but Gladstone, 23¾°, had but 6 ins. that month. Inland from Mackay 130 miles, on a high plateau, only 3 ins. fell at Clermont in March, out of an annual 28 ins. The total monthly fall at Mackay during 1878 was—January, 4 ins.; February, 7 ins.; March, 41¼ ins.; April, 1¾ ins.; May, 4¾ ins.; June, 6 ins.; July, 3 ins.; August, 2 ins.; September, 2 ins.; October, 3 ins.; November, 3½ ins.; December, 11¾ ins. At Cardwell, with a total of 93½ ins., only 14 ins. fell in five months: June, August, September, October and November. Townsville, out of 38½ ins., had only 6 ins. from April to October. Bowen, of its 49 ins., had but 9 ins. in eight months: April to December. Herbert, a sugar district, in five months, January, August, September, October and November, showed but 11 ins. of 85 ins. Clermont, of the celebrated Peak Downs, had not an inch fall in either January, April, June, August or October, with 1 in. for September, 1 in. for November, but nearly 7 ins. for both May and December. The health of Mackay was good for Europeans, but far from that in the case of the imported Polynesian sugar

Month.	Temperature. Absolute Max. 1876.	1877.	1878.	1879.	Absolute Min. 1876.	1877.	1878.	1879.	Mean Max. 1876.	1877.	1878.	1879.	Mean Min. 1876.	1877.	1878.	1879.	Rainfall. 1876. Amount.	Days.	1877. Amount.	Days.	1878. Amount.	Days.	1879. Amount.	Days.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	Ins.		Ins.		Ins.		Ins.	
January	96	103	107	103	68	68	66	67	90·4	90·6	93·1	90·7	72·9	71·6	71·6	70·8	8·34	16	8·85	19	5·63	16	10·88	22
February	95	94	102	108	65	65	65	66	85·3	87·5	96·2	92·4	70·2	69·9	72·4	70·5	8·92	12	9·90	22	9·18	14	7·89	12
March ..	90	90	98	95	65	65	62	67	85·1	84·4	86·2	85·2	70·4	69·7	71·5	71·1	23·36	14	19·88	30	34·70	30	18·03	27
April	89	90	95	89	59	54	59	59	81·2	83·5	87·1	80·5	63·1	63·0	64·4	65·9	2·20	9	3·12	19	0·98	8	10·99	19
May	84	92	92	90	54	37	46	40	77·0	83·9	80·4	78·0	62·6	56·0	59·2	52·9	11·56	18	0·05	5	3·02	11	1·85	6
June	79	80	83	80	43	43	35	40	72·9	75·8	75·1	72·3	56·6	53·9	49·7	50·8	4·05	13	2·77	11	5·35	4	2·05	6
July	75	83	84	82	38	37	41	36	69·1	75·9	78·5	73·8	48·9	47·9	49·6	49·8	2·30	7	0·67	8	0·66	6	1·41	5
August ..	84	93	92	88	41	40	..	44	75·3	81·9	81·0	79·1	52·6	47·1	..	55·9	0·29	7	0·21	3	0·09	2	4·16	9
September	97	93	97	97	40	44	..	48	85·0	84·8	86·9	86·4	54·7	56·5	..	58·2	0·67	6	2·70	10	1·76	10	1·67	5
October ..	105	104	100	90	40	51	..	54	94·0	91·9	91·5	81·8	58·6	59·0	..	64·0	2·74	8	0·01	1	4·32	4	3·76	12
November	109	104	102	96	49	63	..	61	99·8	97·5	94·6	90·3	65·3	68·4	..	67·6	2·22	8	1·53	4	3·57	7	0·15	1
December	104	115	104	102	64	66	..	64	97·4	98·8	96·6	93·9	68·3	71·0	..	72·6	3·58	9	3·62	9	10·72	15	1·22	4
Year ..	109	115	107	108	38	37	..	36	84·4	86·4	87·2	83·6	62·0	61·1	..	62·5	70·23	127	53·31	141	79·98	127	64·06	128

Rainfall at Alexandra Plantation, Mackay, Queensland, by J. Ewen Davidson.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Total.
	Ins	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
1868	1·50 (?)	20·00 (?)	6·12	2·96	11·23	1·41	4·57	0·62	0·10	0·89	1·28	4·72	55·40
1869	5·96	12·27	21·37	8·37	4·53	2·31	0·47	0·81	0·63	0·54	2·03	5·97	65·26
1870	29·63*	21·82*	17·62*	11·68*	2·01	1·94	2·14	2·39	1·70	4·67	6·26	6·14	108·00
1871	28·47	7·10	10·93	1·99	1·90	2·92	0·00	0·27	2·75	9·12	4·23	10·62	80·30
1872	15·40	12·13	2·07	0·00	2·95	0·60	0·35	0·75	0·48	0·07	4·47	6·87	46·14
1873	21·53	6·18	8·64	4·44	2·39	5·24	1·38	1·32	0·68	0·19	2·25	14·82	69·06
1874	19·14	6·99	14·42	6·05	5·12	3·58	4·14	0·00	2·89	4·65	1·50	14·38	82·86
1875	18·33	33·97	1·49	26·70	12·63	1·54	3·75	0·89	0·35	0·05	2·12	3·60	105·42
1876	8·60	6·50	13·42	2·25	8·57	3·74	2·26	0·16	0·15	1·39	1·91	4·06	53·01
1877	9·42	14·01	32·39	4·35	0·06	3·88	0·82	0·13	0·88	0·84	1·66	3·80	72·24
1878	5·95	5·69	42·95	1·00	3·74	5·05	0·27	0·49	2·00	3·14	3·69	11·49	85·46
1879	19·38	8·86	20·25	11·24	1·56	1·68	1·21	3·63	1·71	4·74	0·09	0·83	74·88
Mean ..	15·27	12·94	15·97	6·75	4·72	2·82	1·78	0·96	1·19	2·52	2·62	7·28	74·84

* These are averages; the actual total for the four months of January, February, March and April is 80·75 inches.—J. E. D.

workers. The bracing airs favouring the Queensland tropics are trying for the coloured men, on a change from a vegetable to a meat diet. Of 14,000 imported, 6,000 returned home safely, but 1,700 died. As a Colony, Queensland enjoys much of its healthiness on account of the character of its vegetation, and the prevalence of sea airs on the eastern side.

The PRESIDENT (Mr. Symons) said that Sir Rawson Rawson, when Governor of Barbadoes, published a Report on the Rainfall of that island in its relation to the growth of sugar, in which he showed how closely curves of the rainfall and of the crop of sugar followed each other. The difference between the greatest and least falls at Mackay was from 108 ins. to 46 ins., or not much more than the normal differences in this country of rather over two to one.

THERMOMETRICAL OBSERVATIONS ON BOARD SHIP. By Capt. WARREN FREDERICK CABORNE, R.N.R., F.M.S.

[Read November 17th, 1880.]

THE best position in which permanently to place thermometers on board ship is a problem somewhat difficult of solution, for so very many varying circumstances have to be taken into account and allowed for. For instance, during a voyage, the course of the vessel is constantly being altered, and the conditions of the position, which for a time may have been admirable, are materially changed thereby. Again, the thermometers, in order that their readings may be accurate, have to be protected from spray, sunshine and local temperature; a work of no little difficulty at all times, but more especially so in iron and steam ships.

With respect to my own steamer, the 'Oakdale,' I had special difficulties to contend with, from the fact that the chart room, house and main deck forward were constructed of iron. Nevertheless, I obtained what may be considered as a fairly favourable position for the screen on the top of the house, which was, of course, decked over with wood.

Previous to leaving London, I had, by the kindness of Captain Toynbee, been furnished with two Meteorological Office screens, and also two sling thermometers. The first screen—hereafter called the fixed screen—I attached to the after part of a large teak-wood meat safe on the house. In this position the thermometers were exposed to a free current of air on three sides, and, as the safe was of louvre work, the circulation of the air was not materially checked on the fourth. The other screen—called the shifting screen—I moved about, when experimenting, to the various sides of the safe (having had hooks screwed in for the purpose), according to whichever position appeared to be most favourable for correct observations; from the annexed tables it will be seen with what results.

By this means the thermometers were continually shaded, and that, I think, in a better way than they would be by a small special awning, which, in many cases, will be found to do that which it is expressly intended to avoid, namely, increase the temperature. Of course, the large awnings were spread, in the Red Sea, at a height of about eight or nine feet from the deck.

In comparing the observations, the sling thermometer has been accepted as the standard, and all corrections have been applied.

TABLE I.

Hours.	Fixed Screen, Dry.	Sling Ther. Dry.	Error of Fixed Screen, Dry.	Fixed Screen. Wet.	Sling Ther. Wet.	Error of Fixed Screen, Wet.
	°	°	°	°	°	°
Noon	61·2	58·5	+2·7	55·7	54·7	+1·0
4 p.m.	56·5	56·5	0·0	52·5	52·5	0·0
Noon	56·6	55·0	+1·6	49·3	48·5	+0·8
4 p.m.	54·2	54·4	−0·2	48·3	48·4	−0·1
8 a.m.	55·2	55·3	−0·1	49·3	48·7	+0·6
Noon	57·5	56·7	+0·8	50·8	50·5	+0·3
Noon	63·2	60·0	+3·2	55·3	52·5	+2·8
4 p.m.	60·4	58·7	+1·7	52 7	49·7	+3·0
Noon	66·2	61·7	+4·5	59·3	55·5	+3·8
4 p.m.	61·2	59·5	+1·7	55·3	55·3	0·0
Noon	73·6	70·5	+3·1	61·5	58·7	+2·8
4 p.m.	71·2	70·1	+1·1	61·0	59·3	+1·7
8 a.m.	72·4	71·7	+0·7	66·3	66·3	0·0
Noon	75·4	73·7	+1·7	68·3	66·7	+1·6
4 p.m.	75·2	73·5	+1·7	69·5	66·8	+2·7
8 a.m.	78·8	78·5	+0·3	73·2	72·7	+0·5
4 p.m.	81·3	79·0	+2·3	73·4	71·5	+1·9
8 a.m.	80·8	80·5	+0·3	76·2	74·7	+1·5
4 p.m.	82·0	81·5	+0·5	78·2	76·5	+1·7
4 p.m.	83·3	82·5	+0·8	77·2	76·7	+0·5
Noon	79·7	79·8	−0·1	74·7	76·3	−1·6
4 p.m.	81·3	82·0	−0·7	75·5	76·2	−0·7

TABLE II.

Hours.	Shifting Screen, Dry.	Sling Ther. Dry.	Error of Shifting Screen, Dry.	Shifting Screen, Wet.	Sling Ther. Wet.	Error of Shifting Screen, Wet.
	°	°	°	°	°	°
Noon	59·2	58·5	+0·7	53·5	54·7	−1·2
4 p.m.	56·2	56·5	−0·3	52·3	52·5	−0·2
Noon	54·7	55·0	−0·3	47·8	48·5	−0·7
4 p.m.	53·9	54·4	−0·5	48·2	48·4	−0·2
8 a.m.	55·2	55·3	−0·1	49·3	48·7	+0·6
Noon	57·6	56 7	+0·9	50·8	50·5	+0·3
Noon	60·1	60·0	+0·1	52·7	52 5	+0·2
4 p.m.	58·9	58·7	+0·2	51·8	49·7	+2·1
Noon	64·1	61·7	+2·4	57·8	55·5	+2·3
4 p.m.	60·2	59·5	+0·7	54·6	55·3	−0·7
Noon	71·5	70·5	+1·0	60·8	58·7	+2·1
4 p.m.	69·2	70·1	−0·9	58·7	59·3	−0·6
8 a.m.	72·4	71·7	+0·7	66·3	66·3	0·0
Noon	75·4	73·7	+1·7	68·1	66·7	+1·4
4 p.m.	74·2	73·5	+0·7	68·2	66·8	+1·4
8 a.m.	78·8	78·5	+0·3	73·2	72·7	+0·5
4 p.m.	80·3	79·0	+1·3	73·4	71·5	+1·9
8 a.m.	80·3	80·5	−0·2	75·6	74·7	+0·9
4 p.m.	81·5	81·5	0·0	78 1	76·5	+1·6
4 p.m.	82·3	82·5	−0·2	76·6	76·7	−0·1
Noon	79·7	79·8	−0·1	76·3	74·7	+1·6
4 p.m.	81·3	82·0	−0·7	76·2	75·5	+0·7

It will be noticed that in a few instances the sling thermometer reads the higher of the two.

The readings were taken in the Mediterranean and Red Sea, when outward bound, in the month of March 1879. The weather was fine at the time of each observation.

By a comparison of the figures in the tables the following results are obtained, viz.:

The dry bulb in the fixed screen when compared with the dry sling thermometer shows an average error of + 1°·3.

The wet bulb in the fixed screen when compared with the wet sling thermometer shows an average error of + 1°·2.

The dry bulb in the shifting screen when compared with the dry sling thermometer shows an average error of + 0°·5.

The wet bulb in the shifting screen when compared with the wet sling thermometer shows an average error of + 0°·8.

Consequently, shifting the screen reduces the average error of the dry bulb by 0°·8, and of the wet bulb by 0°·4.

It is a matter of regret that the series of observations are not more regular; that is, with regard to the times of observation, as it would have been much more satisfactory to have had constant readings and comparisons for the three principal divisions of the day, namely, 8 a.m., noon and 4 p.m.

In passing, I may remark that when these observations were taken, I had no definite idea as to the manner in which they were to be compared.

The object of this paper is to show that a careful observer, on board ship, by shifting his screen round a companion, skylight, or any other construction which will protect it from the sun, &c., may obtain readings very nearly in accord with the truth, or, at any rate, to a greater degree of accuracy than if the screen remained fixed.

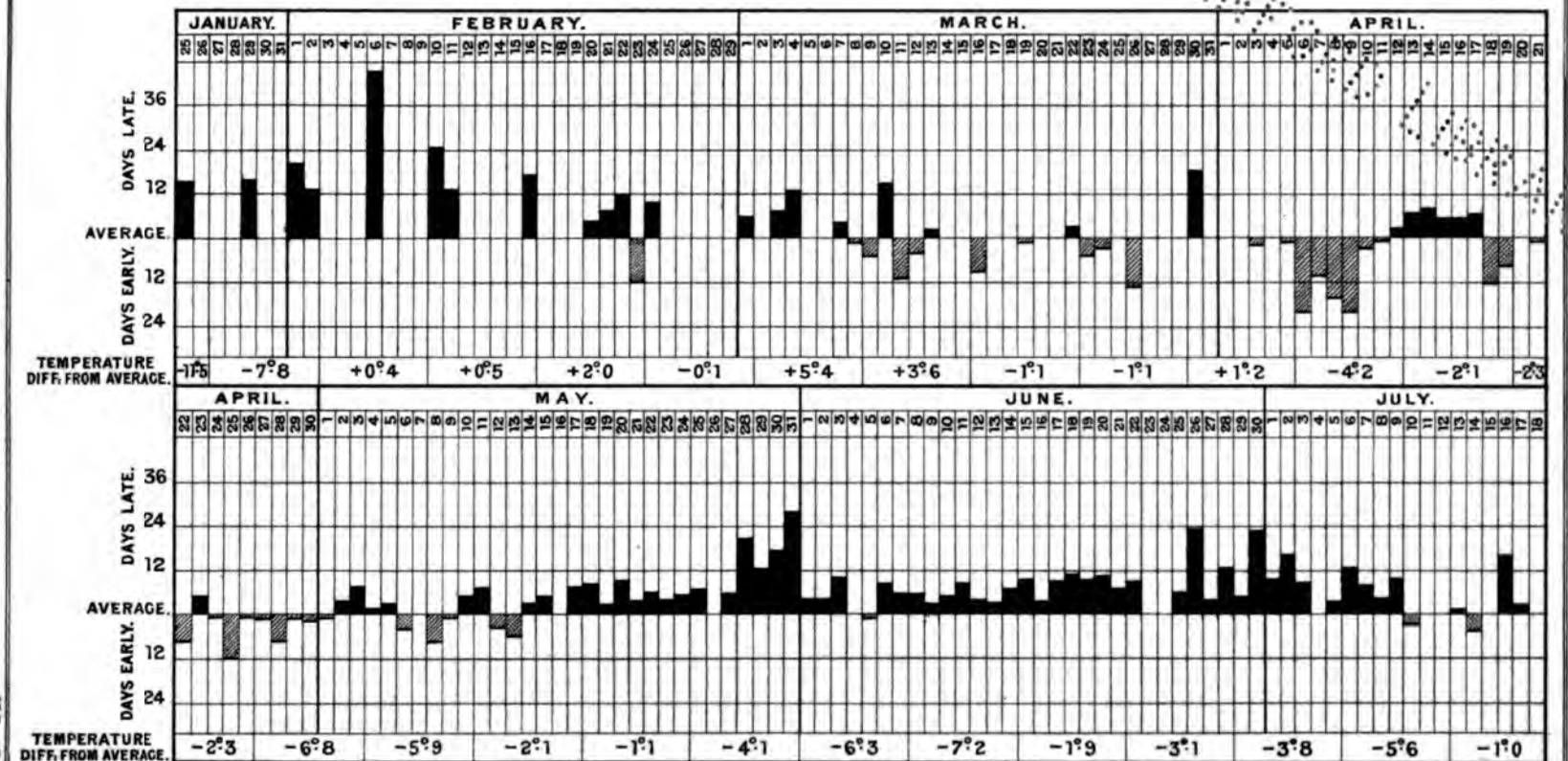
It may be urged that very few observers will be found willing to take the trouble to constantly move their screens, but I am not sure that it would be so if the advantages of the proceeding were pointed out to them; and, moreover, it would be but a trifling matter for the observer, or the officer of the watch, to arrange the screen a few minutes before the time of observation. I, for one, do not believe that absolute exactitude will ever be obtained, but, at the same time, it is the duty of an observer to take any means in his power to minimise error.

DISCUSSION.

Mr. C. HARDING said that as a proof of the care given to the observations made with the sling thermometer, he would mention that occasionally, to ensure a good result, Captain Caborne had used the sling thermometer in four different parts of the ship, viz. on the poop, bridge, forecastle weather side, and forecastle centre. He thought that the present form of screen used on board ship gave far too high temperatures when at all exposed to the sun's rays, and in his opinion the screen would be much more reliable if it were double louvred instead of single louvred.

Mr. MAWLEY said that he had, at different times, taken very careful thermo-

FLOWERING OF PLANTS,-1880.



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metrical observations on board both sailing vessels and steamers, and that, from the experience thus gained, he had arrived at the same conclusions as those expressed by the author of the paper and also by Mr. C. Harding. In the one case there was the necessity, if anything like reliable results were to be obtained, of frequently changing the position of the thermometers, particularly on steamers; while in the other, the protection afforded by the shallow single louvred screen at present in use was, on many occasions, quite insufficient. The sling thermometer had of late years been frequently employed as a standard of comparison, and he thought that, if officers could but be induced to use this instrument, it might now with advantage altogether supersede the shaded thermometer for all observations of air temperature taken on board ship.

Mr. WHIPPLE inquired whether any further experiments were known to have been made on the method of protecting thermometers from direct solar radiation by enclosing the bulbs in double conical shades, having highly polished silver surfaces open top and bottom to allow free circulation of air. He remembered such an arrangement having been used by Mr. Welsh, in his balloon ascents, and thought it might be suitable for nautical observers.

The PRESIDENT (Mr. Symons) said that the account of the mounting of thermometers mentioned by Mr. Whipple was published in the Philosophical Transactions of the Royal Society for 1853.* In the thermometer screen experiments which were made at Strathfield Turgiss, an aspirated thermometer was placed in a cylinder of platinum about $\frac{3}{4}$ in. in diameter. He thought that if the screens used at sea were covered with canvas, they would be greatly improved.

REPORT ON THE PHENOLOGICAL OBSERVATIONS FOR THE YEAR 1880. By the Rev. THOMAS ARTHUR PRESTON, M.A., F.M.S. (Plate II.)

[Read December 15th, 1880.]

RETURNS, more or less complete, have been sent in from no less than 48 localities, and, what is perhaps of more importance, specimens have accompanied a great many of the Returns. Former observers still continue on our List, and their observations will soon become of considerable value, as *continuity of Records* is of very great importance.

In addition to our regular staff of observers, notes have been collected from every available source, and more especially from the 'Natural History Journal' and the 'Midland Naturalist,' the Editors of those periodicals having kindly allowed free use to be made of any information supplied by them, and our best thanks are due to them for their liberality. In the former periodical, Tables have been regularly printed, summarising the observations on a few plants from no less than 74 stations, and thus a considerable mass of material is constantly accumulating.

Subjoined is the List of Stations with the observers' names :—

	1. Maker	Cornwall	Rev. P. H. Newnham, M.A., F.M.S.
†	2. Babbacombe	Devon	E. E. Glyde, F.M.S.
	3. Totnes	Devon	T. H. Edmonds, F.M.S.

* An Account of Meteorological Observations in Four Balloon Ascents, by John Welsh, 'Phil. Trans.' 1853, p. 313.

The observers marked thus (†) send specimens with their Phenological Sheets.

†	4. Trusham	Devon	Rev. W. Moyle Rogers.
	5. Westward Ho	Devon	E. A. Evans.
	6. Yeovil	Somerset	Rev. J. Sowerby, M.A.
	7. Wincanton	Somerset	W. Galpin.
†	8. Salisbury	Wilts	W. Hussey.
	9. Downside	Somerset	Rev. C. B. Kengelbacher, O.S.B.
	10. Strathfield Turgiss	Hants	Rev. C. H. Griffith, B.D., F.M.S.
†	11. Marlborough	Wilts	Rev. T. A. Preston, M.A., F.M.S.
†	12. Isleworth	Middlesex	Miss E. A. Ormerod, F.M.S.
†	13. Watford	Herts	J. Hopkinson, F.L.S., F.M.S.
†	14. St. Alban's	Herts	Mrs. Arnold.
†	15. St. Alban's	Herts	A. E. Gibbs, Miss R. C. White, and G. Willshire.
†	16. Harpenden	Herts	J. J. Willis.
†	17. Ware	Herts	R. B. Croft, R.N., F.L.S.
†	18. Sawbridgeworth	Herts	Miss Simpson.
†	19. Hertford	Herts	R. T. Andrews.
†	20. Hertford	Herts	H. C. Heard.
†	21. Throcking	Herts	Rev. C. W. Harvey, M.A., F.M.S.
†	22. Hoddesden	Herts	Miss A. Warner.
†	23. Berkhampstead	Herts	A. S. Eve.
†	24. Kimpton	Herts	Rev. T. D. Croft, M.A.
	25. Addington	Bucks	J. Mathison.
	26. Bradenham	Bucks	Rev. H. L. Graham.
	27. Oxford	Oxfordshire	W. M. H. Milner.
	28. Bocking	Essex	H. S. Tabor, F.M.S.
	29. Odsey	Cambridgeshire	H. G. Fordham, F.G.S.
	30. Cardington	Beds	J. McLaren, F.M.S.
†	31. English Bicknor	Gloucester	Miss L. Chapman.
	32. Cheltenham	Gloucester	R. Tyrer, B.A., F.M.S.
†	33. Bishop Frome	Hereford	Miss L. Chapman.
†	34. Uppingham	Rutland	W. H. Jones.
†	35. Hatton	Lincolnshire	Mrs. Jarvis.
	36. Great Cotes	Lincolnshire	J. Cordeaux.
†	37. Farley	Staffordshire	C. L. Wragge, F.R.G.S., F.M.S.
	38. Belton	Lincolnshire	Miss F. H. Woolward.
†	39. Geldeston	Norfolk	Miss S. S. Dowson.
	40. Sparham	Norfolk	F. Norgate.
	41. Chester	Cheshire	A. O. Walker, F.L.S., F.M.S.
†	42. Parbold	Lancashire	Mrs. Coombs.
	43. Middleton-in-Teesdale	Durham	W. M. H. Milner.

It will be observed that very few of these localities are in the North of England, but this defect is being gradually remedied, and by the aid of the

The observers marked thus (†) send specimens with their Phenological Sheets.

Editors of the 'Natural History Journal' and 'Midland Naturalist,' we may be able to secure several observers in Yorkshire and elsewhere during the ensuing year.

Miss Chapman continued the observations at Bishop Frome after the departure of Rev. H. L. Graham to Bradenham, but she had afterwards to remove to English Bicknor; no successor could be found to take her place, consequently our series of observations has ceased for Bishop Frome. The Returns from Middleton-in-Teesdale have been supplied by Mr. W. M. H. Milner, from observations made by a Field Club lately started in that locality.

By a curious coincidence, our Phenological Year begins with October 1st; and very nearly about this date, in 1879, the weather experienced a remarkable change. From an extremely wet period, an unprecedentedly dry one set in, which lasted till February. After a wet February a fine dry March followed, then a fine, though showery April, an extremely dry May, a dull, showery June, a drenching, stormy July, and, finally, a magnificent August and September. Agriculturally speaking, as far as the greater part of the district over which the Phenological Stations are situated, the year may be considered as disappointing. Till June the weather was such as has rarely been experienced for farm operations. The severe cold of the winter broke up and mellowed the soil, and the dry open weather enabled farmers to clear their land from the excessive growth of weeds caused by the damp of the year before. The dry May was not favourable for the Hay, which suffered severely in some places, but still a crop with far more real nourishment in it than could be obtained from a rank growth would have been secured had it not been for the terrible floods of July, which not only seriously injured the crop, so that it was frequently not worth the trouble of removing off the land, but also carried it entirely away in low-lying districts. The Corn, again, which was looking most promising till July, suffered much during that damp period, and had it not been for the subsequent fine weather would have been ruined.

But the unfavourable season of 1879 produced very serious effects on vegetation, especially on trees and shrubs, and their produce. The young wood of the trees was not ripened, and as a natural consequence the severe winter killed an enormous quantity of some kinds, and greatly injured others. *Laurustinus* was very generally killed to the ground, and in some districts the destruction of other shrubs was severely felt. The Evergreens in many cases lost large quantities of their leaves—Hollies especially are mentioned by several observers, and privet hedges were sometimes quite leafless. With respect to fruit trees, Apples and Pears in some localities (but not all) were hardly able to put forth any bloom, and the crops were consequently extremely poor. Wall fruit was also a general failure, but this was partially owing to severe weather when the trees were in bloom, for in some instances the show of bloom was splendid. Gooseberries and Currants produced enormous crops, and Strawberries were very fine (finer than had been known for many years past at Cardiff and other places), but they lasted an unusually short time.

Seeds generally ripened with difficulty; much of the Corn could not be ground, and a great deal was mixed up with roughly ground Indian Corn, and flavoured to induce the cattle to eat it. The crop of ordinary garden seeds was also far below its usual quality, and some of the favourite garden flowers were consequently very poor.

A very curious malformation of the *Colchicum*, probably resulting from the wet season of 1879, was noticed in two or three localities, especially by one of our observers—Miss L. Chapman. This plant in the Autumn sends up a portion of its flower above ground (the flower resembling a mauve-coloured Crocus), the seed vessel and leaves not appearing till the following Spring. In 1879 the number of flowers was remarkably small, but in the Spring of 1880, at the time when the seed vessels and leaves ought to appear, several flowers appeared with the leaves, and likewise a very curious monstrosity: the flower instead of being mauve-coloured was a dingy white, the petals, not like those of the Crocus, but long and narrow, the stamens without pollen, and the seed vessels merely rudimentary.

Monstrosities, as far as I have been able to learn, have not been very numerous, but, in two or three gardens, the cabbage leaves have frequently assumed a funnel-shape, or have sent out a portion of the mid-rib ending in a funnel-shaped expansion. As a rule, wild flowers have been very much scarcer this year even than in 1879. Certainly, about Marlborough, the number of species in blossom at any one time has been far less than usual, and the number of specimens of a species very much so. The Hawthorn appears to have universally failed, and Blackthorn very nearly so, whilst some water plants, on the other hand, seem to have been greatly benefited by the damp season of 1879. The display of Cuckoo Flower *(Cardamine pratensis)* and of the Marsh Marigold *(Caltha palustris)* has been generally remarked as magnificent. Of some few plants about Marlborough, *e.g.* of the Wild Rose *(Rosa Canina)*, the display of bloom was something wonderful, but it lasted a very short time in perfection—the total duration of bloom being only six weeks.

The diagram on Plate II. will give a very good idea of the general effect of the season upon vegetation. It is the result of 16 years' observations upon about 450 plants, cultivated and wild. It will be seen at a glance, that in 1880 flowering was later than the mean till about the second week in March; but from that time, with a few short intervals, it was before the average till about the middle of May, and after that later. When we take temperature into consideration, a very curious fact presents itself. The temperature was never very greatly different from the mean (as published in the Agricultural Statistics), but, speaking generally, when plants were *later* than the average, the temperature was *above* the mean, and when *earlier*, the temperature was below the mean, *i.e.* till the middle of May, after which late flowering and a temperature below the mean prevailed. Does not this show that a considerable period of high or low temperature is required to affect vegetation as a whole?

Some years ago, when consulting Sir Joseph Hooker about drawing up a table giving the connection between temperature and flowering, he suggested

that a period of *six weeks* should be taken, as that which would probably be the time for temperature to affect the time of flowering; and such, it will be found, is roughly the inference to be drawn from the diagram. It must be remembered that 15 years is a *short* time to take for generalisations of this sort, and there *must* be variations, for we cannot expect anything like the same accuracy in phenomena of phenology as even in those of temperature. Had it not been for a request for "averages" made last year, I should not have ventured upon a diagram of this sort now; but, such as it is, it seems to promise useful results, when continued carefully for a few more years. With only three exceptions, water and marsh plants were later than their averages: and of these three exceptions, two were only five days before their average, the third, the Marsh Marigold (*Caltha palustris*), was a long time coming fairly into bloom—it was 12 days earlier than its average.

Foliation has been earlier (in some cases much earlier) than in 1879, and though it has been healthy and good, it has only been luxuriant on the Ash; Elm leafage has been throughout average or under-sized, and of a true green, not the very dark tint of 1879.

A very decided meteorological effect upon fruit has been observed by Miss Ormerod. The Apples, when boiled, "jellied"—whilst last year the sun had not sufficient influence to bring them to that particular state of ripeness.

Among the *special* features of the year may be mentioned the great quantity of certain insects. *Aphis* was in astonishing numbers in the early part of the year. The apple shoots, before the leaves expanded, were in almost every case (about Marlborough) covered with this "green fly," and among wild plants the Mealy Guelder-Rose (*Viburnum lantana*) was especially attacked by them. *Wasps*, again, have been in extraordinary numbers, and dreadful accounts of them have been sent to the various Entomological Periodicals—their numbers appear to have exceeded all previous experience. The larvæ of the Gooseberry Moth (*Abraxas Grossulariata*) and of the Gooseberry Saw Fly (*Nematus Ribesii*) have also been extremely destructive; and finally, as an undoubted result of the wet season of 1879, the larvæ of the Crane Fly (*Tipula*) have been a perfect plague in some localities, and Sheep Ticks in others. With respect to the latter, Miss Ormerod writes, "I believe that the excessive wet of last year having caused a rank luxuriant *herbage* (such as these disagreeable creatures frequent, and *from* which they fasten on the sheep), has much to do with the matter."

The scarcity of small birds has been universally noticed: some, no doubt, perished from the cold, but vast numbers had migrated. The enormous numbers of Larks which passed over the eastern counties, on their way from England, on the outbreak of cold weather was astonishing.

Turning now more to details:—

1879. During OCTOBER vegetation remained but little changed. About 300 plants were in flower at the end of the month, and though there were some sharp frosts, yet the unusual dryness prevented their having any serious effect on vegetation. The month was very sunless at Greenwich

(only 66·7 hours out of a possible maximum of 328·7). The Ivy, at Marlborough, did not open a flower during the whole month. The effect upon leafage was very curious. No doubt, owing to the want of sun, the leaves had not ripened, and they therefore remained on the trees for a very long time, even after they were dead.

The severe frost which occurred on October 16th, would in ordinary years have stripped the Mulberry of its leaves, but the only effect produced this year was that the leaves at the extremities of the branches were killed, but remained on the tree. By the end of the month many trees had begun to shed their leaves plentifully. The Lombardy Poplar and Horse Chestnut had become quite leafless, but the Beeches were in their finely tinted state. Limes just getting leafless. Ash green, but leaves falling, whilst Oak and Elm, though losing leaves, still remained quite green ; and even as late as December 8 an Oak was observed still green in leafage, whilst an Elm had lost only about one-third of its leaves. The Fig was not leafless till November 5, the Mulberry till November 14, and Elms *generally*, not leafless till November 30, or even later, when many of the leaves that fell then were still green. In some places the unusual sight of skating under green trees could be seen.

November still continued very dry as regards rain (but owing to mists it cannot be called a dry month), and especially towards the end of the month it was very cold. This was most beneficial to the farmers, as they were able to get their Spring Wheat sown, though, on the other hand, much corn remained uncut in the middle of October, and farm operations were consequently much delayed. By the middle of the month most trees had become defoliated, and yet wild flowers continued to be fairly plentiful. After some severe frosts on the 14th, 15th and 16th, over 100 species could be gathered during a walk, and during the whole month 206 species had been gathered in flower, 121 of these after the frosts alluded to. An observer at Coundon, near Coventry, mentions in the 'Midland Naturalist,' that White Plums (golden drop), Damsons and Pears were on the trees, and unripe, after every leaf had fallen from them, on the 15th November. In this locality, too, the last field of wheat was not carried till the last week of the month.

December will ever be memorable for the extreme severity of the cold, especially during the first week, and yet no less than 86 plants were found in blossom on the 8th. This seems to have been the final struggle, for after that date for many weeks scarcely a flower could be seen. Hips and Haws, and fruit of that kind, were plentiful, and, perhaps owing to the scarcity of birds, remained all the winter on the bushes. Berries of Holly and especially Ivy were very scarce. At Nottingham an Oak was seen still with leaves on the 20th, and at Isleworth green leaves were still on the Peach, Almond and especially Nectarine, on the 17th. Snow to a small amount fell in November, and this was not entirely melted by the middle of December. This want of snow must have affected vegetation—it would be a good plan to record the duration of snow on the ground, as it will probably be found that any unusually great destruction of plants by cold will be caused by the want of this natural protection.

1880. JANUARY was a dry but gloomy and dull month (much sunshine at Coston) and very cold, though there was slight improvement about the middle of the month. It was very favourable for farm work, but vegetation was generally much retarded. At Marlborough, single specimens of the Daisy and of the Creeping Crowfoot (*Ran. repens*) were seen on the 31st, and the next day a Primrose; but though the latter was apparently quite fresh when gathered, it was really dead, for it lasted but a very few hours when put into water: in fact this extraordinary dryness of the winter is especially remarkable, and served to prevent many of the withered flowers and leaves from decaying. The two flowers mentioned above were all that were seen about Marlborough, not even the Groundsel or Chickweed appearing in flower; but at Isleworth, no less than 11 species were seen; at Yeovil, 20; at Sidcot, 13; and at Plymouth the enormous number of 59 were found between the 1st and 3rd January. The Hairy Bittercress was found in flower at Stroud on the 4th; the Snowdrop, at Mount Mellick, on the 10th, and at Sidcot and Lisburn on the 29th, and at Silloth and Wigton (in Cumberland) on the 31st; the Lesser Celandine (*Ran. Ficaria*) at Plymouth on the 11th, and at Redruth and Bristworth (in Yorkshire) on the 31st; the Sweet Violet at Lisburn on the 24th; and the Hazel at Scarborough on the 30th, and at Lisburn on the 31st. At Trusham the Barren Strawberry (*P. Fragariastrum*) had several flowers open on the 9th, evidently survivors from last year; the proper flowering took place on the 31st.

These dates, but especially those in the northern localities, are all very remarkable. *Moles* appear to have come in great numbers in many places, though the ground was frozen. One observer states that he has found many of them dead on the surface of the ground, and concludes that they were driven up by want of food, and perished from cold and hunger; these animals are very voracious, and cannot live very long without food.

The dry period ended about FEBRUARY 4th, when the weather became very variable, generally very wet, but warmer—in some places even "genial;" but whether vegetation was stunned, as it were, by the cold, or for some other reason, it did not progress very much during the month, though it may be considered to have really started then, the few notices in January being quite exceptional. Snowdrops were generally in flower, as well as Crocuses; and Dog's Mercury, Coltsfoot, Lesser Celandine, and Hazel flowered in many places. The great feature of the month was the excessive scarcity of Hazel Catkins, noticed by several observers. At Marlborough the fertile flowers were out before the barren ones, a very unusual circumstance.

At Sidcot there were 27 plants in flower, at Marlborough 19, at Isleworth only 2, at the beginning of the month, but 11 by the end, and at Yeovil 22. At Isleworth "vegetation progressed with the rise of earth temperatures, accompanied by occasional rain and high readings of the solar thermometer, and was checked coincidently with the fall of temperature on the 25th."

MARCH, as a rule, was fine and dry, though with a cold east wind, and was particularly favourable for farming operations. Vegetation was decidedly

progressing, but not remarkably fast. At Farley, on the 15th, "Grass was as forward as it was in the middle of May last year;" whilst at Bradenham "the long continuance of cold winds had kept everything back." Spring flowers began to open at their proper time, and hedges became tinted with the opening buds, and were even green in sheltered places. Primroses were generally in flower, and in some localities had been plentiful last month. This is an unsatisfactory plant to note, as it is frequently in flower in November and December; in fact, in 1878 specimens were found every month throughout the year. Though earlier than in 1879, the Blackthorn was very late, and only began to bloom quite towards the end of the month even in the earliest localities, and was particularly noticeable for the extreme scantiness of its bloom,—in fact, "it did not bloom *at all* in the earliest localities," at Maker. At this place "all dates were from 7 to 20 days late," whilst on the other hand the Lily of the Valley bloomed on March 29, about 26 days earlier than usual. This affords a very good instance of the unsatisfactory results from *cultivated* flowers. The recorder of the 'Natural History Journal' has decided, after practical experience, to entirely exclude cultivated plants from his tables. Peaches, Pears, Gooseberries, and Currants came into flower generally, and the buds of the Horse Chestnut and other trees began to expand, "the young leaves not notably injured by the frosts, excepting some slight discolouration of those of the Black Currant" (at Isleworth). At Isleworth there were 31 wild plants in flower by the end of the month, and at Marlborough 52.

The weather during APRIL was fine yet showery, and still very favourable for farming operations. Vegetation certainly progressed. At Babbacombe "vegetation advanced rapidly, and was forward in the south of England at the end of the month;" whilst, on the other hand, at Downside "last month was in every respect a better month for everything—scarcely an insect or nest to be seen." Lilacs were in flower at Isleworth on the 26th, and Elms, Beeches, Limes, and Horse Chestnuts were fairly covered with leaves; and at Strathfield Turgiss the Oak was in leaf on the 21st. "Apples in very luxuriant flower, Pears in bloom, but the blossom not great in quantity, whilst there was scarcely any on the Ash. At the end of the month the only Ash tree on which more than two bunches of flowers were observable was one which had shed last year's seeds in the ordinary way, many of the Ash trees still retaining them." In fact, towards the end of the month "the growth of the expanded leaves was not observably progressing, apparently from the east wind" (Isleworth), and certainly the extremely few remarks in the observer's returns indicate great stagnation in the progress of vegetation. Plants in flower at Isleworth 63, and at Marlborough 106, by the end of the month; of which 62 came into flower during the month, as against 23 in 1879, and 70 in 1878.

MAY was a cold, sunless and particularly dry month, in fact towards the end the country was suffering from drought. Leafage was good, but the leaves not above the average. The flowering of the Horse Chestnut was remarkably fine, and that of the Apple "most luxuriant." In most localities

the Oak was in full leaf before the Ash showed any signs of bursting its buds. The Wheat crops were generally good on light lands, but the straw was very short. At Hertford "*Orchis mascula* and *Orchis maculata* have been much scarcer than in 1879, from the bulbs not being able to ripen last year, their habitats in and about the district are almost void of them." This scarcity of Orchids was visible also in other localities. At Babbacombe "vegetation made little progress till the 23rd, being parched by the drought, but advanced rapidly in the ensuing wet weather." At Salisbury on the 22nd the Oaks had lost their brown tint, and the latest Elms in the Close were green, though the leaves were not fully expanded. The Oaks were in leaf at Banbury early in the month, and Lilacs were in flower on the 2nd at Strathfield Turgiss, and on the 10th at Boston. Miss Ormerod takes an annual trip from Isleworth to Reading and back, to observe the progress of vegetation. Her report is given on page 26, but it may be mentioned here that the state of leafage was remarkably in advance of what it was in 1879. At Isleworth there were 117 wild plants in flower by the end of the month, and 210 at Marlborough; of which 126 came into flower during the month, as against 153 in 1879.

JUNE was anything but a "typical" month. The weather cold and showery, with very little sun, and a temperature always below the mean; though, on the other hand, it is described as a "fine" month, "with fine growing weather" at Littlehampton, Addington, and some other places. The Wheat, however, looked well, and Potatoes were promising, but haymaking was very late. Nowhere did it begin before the last week of the month, and in many places not till July. The Ash was not in full leaf till about the middle of the month. At Farley, on the 12th, "Grass was not in such an advanced state as this time last year." Corn (Wheat and Barley) came into flower during the last week of June. At Isleworth, "the Apple leafage was rather deficient, and many boughs were dead at the extremities." Notwithstanding the magnificent show of bloom, the Apple Crop was generally a total failure. There were 169 wild plants in flower at Isleworth, and at Marlborough 264, of which 109 came into flower during the month, as against 153 in 1879. The weather, which hitherto had, as a rule, been very favourable to the farmers, and would have been more so had there been a greater amount of sunshine, became almost disastrous to them in JULY. An unsettled, wet, and stormy month, with the temperature below the average, seemed to threaten ruin. The Hay crops were washed away, and the Corn beaten down. A great deal of the former had been cut, but could not be carried, and in some districts the Corn was beaten down and overgrown with weeds, many of the ears were "blind" in the Fen country, and towards the end of the month the Potato disease appeared in several places. At Babbacombe, the Hay harvest did not begin till the 5th and finished on the 24th, and in spite of slight showers till the 11th, it was well secured. The Pastures and Root Crops were suffering from drought till the 25th, when a refreshing rain fell. All crops promised well at the end of the month. At Parbold, Haymaking commenced the first week in July. The foliage was

peculiarly fine, but there was "almost a total failure of Gooseberries and Black Currants" in some places.

The dull and damp weather of June and July continued for the first week in AUGUST, when a delightful change took place, and a hot period set in, which was of enormous benefit to the crops. Wasps appear to have been extremely abundant. Plums were plentiful, but Apples and Pears utterly failed. "The Orchards were ruined by the severe winter, many trees having been killed. Some Apples were only in leaf in July, many had no blossom and great numbers no fruit." At Isleworth, on the contrary, "this year the Apple blossom was luxuriant, followed by a good crop ripening well, and the leafage of the Apple, which was very deficient in 1879, was good. Cabbage, which in the early part of the year was so cut off by the frosts that there was difficulty in purchasing young plants, proved a most luxuriant crop in autumn, and was little injured by caterpillars in the fields. Beet fly attacked the Mangolds to a slight extent. Onions in field cultivation escaped maggot when hop manure was used. The *Tipulæ* (or Daddy Long-legs) grubs, so injurious in many districts, were not noticed as particularly plentiful, and at the end of August it was observed that though the flies were present on damp grass, yet where the herbage was short and the ground dry, none were visible." Lime trees, where young and overhanging dry roads, were losing their leaves fast; older trees, where over grass, but little changed. The dry weather affected foliage generally, and many trees began to show colour. Harvest began about the middle of the month, as a rule, but earlier in the extreme south. The yield was variable, but satisfactory on the whole. At Salisbury it commenced on the 5th; Babbacombe, 11th to28th; Geldeston, 11th; Isleworth, 13th; Bradenham, on the 18th; and at Hatton, on 21st till September 15th.

The Phenological Year (*i.e.* up to SEPTEMBER 30th) finished with a continuance of the fine weather of August. Many trees had begun to turn yellow, but the Oak and Ash continued quite green. Grass was most luxuriant and plentiful. Blackberries numerous in some places, but not in others, whilst a Nut was scarcely to be seen, a natural result of the unsatisfactory blooming of the shrub in the early part of the year. Acorns were fine and plentiful. The great heat had partially affected the foliage, but only to a slight extent. By the end of the month the trees were generally quite green. Virginia Creepers began to change colour about the last week of the month, but otherwise there were no signs of the approaching early defoliation by which almost all trees were bare by the end of the following month. The report of which will be given next year.

Grouping the stations into the following sets:—1. Devonshire (**1-5**); 2. South of the Thames (**6-11**); 3. South Midland (**12-34**); and, considering the Hertfordshire stations as a subordinate group, and reckoning only the earliest date among them; 4. North Midland (**35-24**); and 5 North (**43**), it will be observed from Table I. that Devonshire is generally *later* than South Thames, and in some instances much later, but that the usual course of flowering from SW to NE has been the case again this year. By a careful comparison of the dates of flowering of a large number of

plants, it appears that Wincanton (7) is about one day in advance of Marlborough (11), which is as much as 10 days in advance of Isleworth (12). This being the first year of observations at Wincanton, it is very probable that subsequent years may prove that it is much more in advance of Marlborough than appears from the above calculation, though, from taking a large number of plants, the errors are much diminished. It must also be noticed that the other stations in Devonshire also indicate later dates than at Marlborough, and, therefore, though Devonshire may be milder, it is certainly not an *early* county for flowers.

The great majority of our stations being in the S of England, it has been impossible to compare S with N. But in the 'Natural History Journal,' where the North is fairly represented, it is calculated that "the South is uniformly ahead of the North in the wild flowers and fruits, the mean difference for these is 12 *days*. Taking wild flowers alone, the dates vary by 12 to 8 days. This is a less difference than usual." In previous years, the least advantage of the South has been 2 *weeks*.

From Table II. it will be observed that 1879 was the latest year on record, and next to it comes 1880, except in the very early part of the year, when it was even later than 1879. In the last column has been inserted the average date of the flowering at all the stations, Watford *or* Ware alone being taken. The other stations are fairly distributed, and hence it was deemed advisable to take only one of these two stations so near one another.

Miss Ormerod reports that in the present year (1880) the date of foliation at Isleworth (that is to say of the trees being first clothed with leafage) has been, in almost all the cases noted, earlier than in 1879, and in some instances several weeks earlier. Taking the trees in succession, the following Table will show the dates of the different states and the variations for 1879.

Trees.	(1) Buds bursting.	(2) Young Leaves.	(3) Sprinkled.	(4) In Leaf.	Remarks.
Horse Chestnut	March 14	March 28	April 13	April 29	Earlier than in 1879.
Sycamore.....	....	....	....	April 29	Trees too overgrown for good results.
Maple.....	....	May 4	....	May 16	Earlier than in 1879.
Hawthorn	March 12	....	April 4	April 20	Much earlier.
Ash	....	May 7	May 30	....	(2) earlier; (3) later.
Oak	April 23	April 29	May 11	May 16	(1) a week earlier; (4) 12 days earlier.
Elm*	....	April 4	April 17	May 26	(1) 3 weeks earlier; (4) 9 days to 1 mth. earlier.
Birch	....	April 8	April 13	May 4	20 days earlier.
Beech	....	April 29	May 7	May 16	(1) earlier; (4) same.
Lime†	....	April 13	April 26	May 4	3 weeks earlier.

* Second Shoot June 25. † Second Shoot July 16.

Throughout the season, although the leafage has been healthy and good, it has only been luxuriant on the Ash; Elm leafage has been throughout average or rather undersized, and of true green, not the very dark tint of 1879.

No.	Plant.	1. Maker.	2. Babbacombe.	3. Totnes.	4. Tretham.	5. Westward Ho.	6. Yeovil.	7. Wincanton.	8. Salisbury.	9. Downside.	10. Strathfield Turgiss.	11. Marlborough.	12. Isleworth.	13. Watford.	14. St. Alban's. R. B.	15. St. Alban's.	16. [illegible]
1	ANEMONE NEMOROSA	..	..	..	71	..	72	86	71	74	71	61	86	81	78	73	
2	RANUNCULUS FICARIA	44	73	..	56	..	..	48	63	71		51	70	61	61	44	
3	*Ranunculus acris*	..	140	..	118	..	113	98	107	121	..	103	108	..	..	..	
4	CALTHA PALUSTRIS	..	97	..	90	..	58	93	76	..	89	59	104	64	91	80	
5	*Papaver Rhœas*	..	173	159	..	164	..	163	162	..	170	170	172	..	..	..	
6	*Cardamine hirsuta*	..	73	..	40	..	36	49	64	..	..	58	83	..	..	..	
7	*Cardamine pratensis*	..	97	..	92	..	89	91	87	..	97	99	104	102	101	93	
8	*Draba verna*	..	..	..	..	..	42	52	54	..	93	66	65		..	..	
9	*Viola odorata*	..	..	..	55	..	56	64	65	72	49	67	75	70	68	68	
10	*Polygala vulgaris*	..	..	..	127	..	103	131	107	138	.	129	.	129	..	.	
11	*Lychnis Flos-cuculi*	..	142	141	..	..	..	148	140	..	142	157	144	132	143	..	
12	*Stellaria Holostea*	87	103	..	90	..	94	93	94	..	110	98	108	107	108	..	
13	MALVA SYLVESTRIS	..	166	172	..	..	..	165	164	..	193	161	172	146	139	..	
14	*Hypericum tetrapterum*	..	201	..	198	..	..	200	196	..	..	186	..	189	..	..	
15	*Hypericum pulchrum*	..	187	..	175	178	..	186	176	..	..	188	..	180	..	..	
16	GERANIUM ROBERTIANUM	94	110	..	92	..	114	111	119	..	111	114	146	115	122	..	
17	TRIFOLIUM REPENS	..	143	141	129	..	..	138	140	..	149	144	146	136	143	..	
18	*Lotus corniculatus*	..	143	133	126	..	..	137	124	..	..	137	144	146	156	..	
19	*Vicia Cracca*	..	..	172	170	166	..	169	171	..	..	182	176	176	..	..	
20	*Vicia sepium*	..	118	..	105	..	103	95	111	..	..	109	138	123	135	120	
21	*Lathyrus pratensis*		169	147	..	146	..	158	138	..	..	151	148	..	166	..	
22	PRUNUS SPINOSA	82	103	..	87	..	89	96	80		99	109	101	94	106	..	
23	*Spiræa Ulmaria*	..	175	167	170	166	..	166	167	..	183	166	176	176	178	..	
24	*Potentilla anserina*	..	155	133	127	..	104	131	120	134	135	127	122	139	135	..	
25	*Potentilla Fragariastrum*	20	79	..	31		64	92	59	..	43	59	100	75	80	73	
26	*Rosa canina*	..	..	155	149	153	..	162	159	..	153	150	165	161	162	..	
27	*Epilobium hirsutum*	..	197	..	189	..	..	184	193	..	203	201	187	..	184	..	
28	*Epilobium montanum*	..	..	..	169	162	..	173	171	..	..	170	162	166	168	..	
29	*Angelica sylvestris*	..	..	..	208	162	..	209	200	..	..	211	222	..	..	..	
30	*Anthriscus sylvestris*	..	..	..	..	..	98	96	90	..	108	88	112	108	..	..	
31	HEDERA HELIX	250	..	..	..	..	..	263	251	..	..	257	252	262	..	..	
32	*Galium Aparine*	..	142	..	128	146	..	148	..	..	149	129	143	144	140	..	
33	*Galium verum*	..	182	183	185	168	..	187	175	..	..	182	192	185	187	..	
34	*Dipsacus sylvestris*	..	223	205	..	..	..	205	212	..	..	..	206	..	..	..	
35	*Scabiosa succisa*	..	213	..	208	..	..	174	217	219	209	221	214	200	..	..	
36	*Petasites vulgaris*	..	..	..	..	..	..	85	74	..	96	64	87	..	..	..	
37	TUSSILAGO FARFARA	..	76	..	52	..	57	62	65	65	65	42	70	59	64	63	
38	ACHILLEA MILLEFOLIUM	..	182	182	..	176	..	186	171	..	157	185	173	180	203	..	
39	*Chrysanthemum Leucanthemum*	..	136	142	129	..	115	151	129	..	135	138	146	130	149	..	
40	*Artemisia vulgaris*	..	..	..	201	..	..	..	212	..	..	214	210	..	..	..	
41	*Senecio Jacobæa*	..	193	183	175	169		157	182	..	162	183	173	185	191	..	
42	CENTAUREA NIGRA	..	187	..	173	164	..	162	171	..	173	176	172	180	..	..	
43	*Carduus lanceolatus*	..	182	..	181	..	..	186	189	..	..	196	192	164	..	..	
44	*Carduus arvensis*	..	..	189	180	..	..	182	173	..	..	191	187	..	..	..	
45	*Sonchus arvensis*	..	..	..	202	195	.	..	205	.	..	210	192	..	..	..	
46	*Hieracium Pilosella*	..	138	..	126	146	..	137	124	..		139	151	137	139	..	
47	CAMPANULA ROTUNDIFOLIA	..	..	..	..	..	..	..	180	187	179	190	214	192	201	.	
48	*Gentiana campestris*	..	..	..	..	..	..	..	..	232	..	..	..	..	..	..	
49	CONVOLVULUS SEPIUM	..	201	195	202	..	..	186	191	..	176	201	187	164	198	..	
50	*Symphytum officinale*	..	..	..	..	..	118	121	104	..	..	115	143	124	..	..	
51	*Pedicularis sylvatica*		..	..	99	..	99	114	110	104	..	123	171	124	..	..	
52	*Veronica Chamædrys*	95	113	..	94	..	93	95	85	..	59	114	113	110	121	..	
53	*Veronica hederifolia*	..	..	..	40	..	67	76	70	78	..	81	70	..	..	..	

18. Sawbridgeworth.	19. Hertford.	20. Hertford.	21. Throcking.	22. Hoddesdon.	23. Berkhampstead.	24. Kimpton.	25. Addington.	26. Bradenham.	27. Oxford.	28. Boeking.	29. Odsey.	30. Cardington.	31. English Bicknor.	32. Cheltenham.	33. Bishop Frome.	34. Uppingham.	35. Hatton.	36. Great Cotes.	37. Farley.	38. Belton.	39. Geldeston.	40. Sparham.	41. Chester.	42. Parbold.	43. Middleton-in-Teesdale.
..	54	..	70	68	..		93	..	75	83	..	70	..	n	73	78	90	96	80	86	..	86	..	100	85
..	61	..	73	70	..	..	64	72	56	67	..	66	..	..	66	71	77	66	81	..	..	50	..	72	59
..	100	..	..	.	..	122	122	122	112	..	..	112	..	..	..	..	147	119	135	..	..	..	..	..	..
..	94	..	..	92	..	89	108	..	75	100	..	93	..	..	86	..	109	82	98	..	..	..	..	104	85
..	150	..	..	..	..	..	..	169	164	156	159	157	178	..	..	..	..	173	..	159	..	167	..	..	..
..	70	..	..	..	116	..	106	..	72	..	..	82	..	..	66	74	..	..	86	..	..	..	..	..	79
..	102	..	..	98	..	..	118	115	96	101	..	99	..	113	96	100	107	106	111	..	..	96	..	98	119
..	95	..	..	..	..	..	73	..	48		..	85	..	..	95	46	..	..	..	..	..	67	..	..	..
..	60	..	68	..	..	..	67	66	64	67	64	66	..	..	..	64	77	64	71	..	..	67	49	..	..
..	136	..	..	..	..	..	..	145	150	..	116	..	..	..	136	..	..	171	137	150	..	127	..	..	..
158	146	..	..	..	..		141	..	140	..	..	151	174	..	..	144	160	156	176	161	..	163	..	153	..
..	107	..	..	107	19	..	..	112	108	108	..	114	..	..	108	119	125	118	109	..	..	109	..	97	..
168	158	..	..	..	..	..	..	167	164	..	169	162	.	..	..	165	172	170	..	..	..	158	..	..	..
..	187	..	..	..	..	..	..	..	..	..		206	..	..	..	..	..	207	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	193		124	..	..	..	..	..	..	..	..	..	..	..	..	218
..	118	..	..	114	..	120	132	125	111	111	138	144	..	..	108	102	138	131	112	..	..	95	..	..	147
..	135	..	..	..	..	..	146	..	140	148	..	152	147	..	141	144	162	168	164	157	..	..	..	146	..
..	136	..	..	..	..	..	..	150	133	145	..	..	..	..	138	148	140	161	146	..	..	..	..	..	154
..	162	..	..	..	..	..	..	..	169	178	..	..	183	..	..	185	174	174	..	184	..	..	..	184	..
..	119	..	..	..	..	122	..	114	117	127	..	157	..	..	115	101	..	..	137	157	..	..	..		..
..	146	..	..	..	..	..	..	178	150	145	..	95	169	..		..	172	160	..	166		..	..	191	170
..	97	..	..	92	116	..	108	103	103	102	99	172	..	..	108	101	109	110	..	109		106	102	118	121
176	167	..	..	..	..	..	166	..	163	171	..	128	179	..	..	177	161	182	189	183	..	181	..	185	..
..	137	..	..	..	..	..	..	133	114	145	126	..	142	..	142	137	147	148	..	..	..	..	..	..	..
..	..	..	74	..	98	..	..	71	60	83	..	166	..	..	66	69	88	..	81	..	..	67	53	93	68
..	158	..	..	..	..	..	166	162	153	148	157	192	161	..	..	153	171	173	160	163	..	165	..	176	178
192	190	..	..	..	..	..	..	..	..	194	..	170	202	..	..	200	..	201	209	..	..	197		..	..
..	158	..	..	..	..	..	..	161	164	174	..	207	..	..	138		..		177	173	..	179	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	113		..	..	..	..	..	..	..	..	.	..	..	..
..	110	..	..	..	..	..	115	115	73	111	111	245	..	..	142	105	116	128	133	..	..	100	..	..	..
257	..	..	..	..	..	..	..	..	..	253	..	130	..	..	..	..	..	..	..	..	268	263	..	..	..
..	136	.	..	..	..	.	169	..	133	145	158	183	174	..	152	141	..	162	..	..	..	148	..	..	..
186	177	..	..	..	..	..	174	194	..	..	195	202	190	..	..	..	..	195	207	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	227	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	.	..	..	190	..	..	..	..	215	..	..	..	..	..	..	216
..	78	..	..	..	..	..	109	..	..	..	..	..	..	..	..	..	..	93	104	..	..	..	..	..	..
..	54	..	61		..	..	69	..	50	76	60	61	..	..	65	59	67	63	67	..	..	85	53	72	59
180	159	..		..	..	..	..	185	169	179	..	184	187	..	..	190	.	181	187	..	..	..	..	..	..
.	135	..	..	..	..	..	146	143	122	150	..	125	..	..	138	151	56	156	170	..	..	161	..	..	..
220	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	228	..	..	212	..	..	..	..
..	177	..	..	..	..	..	..	..	..	..	190	184	..	..	..	183	161	187	208	..	..	197	..	..	..
182	156	..	..	..	..	..	..	181	164	180	..	172	169	..	..	..	..	179	187		..	..	..	..	216
..	176	..	..	..		..	..	196		..	..	197	..	..	..	..	..	188	..	..		..	..	..	216
..	163	..	..	..	..	..		174	..	187	..	184	..	..	..	..	..	197	..	..	..	..	..	..	..
..	188	..	..	..	..	..	..	..	..	..	..	195	..	..	..	..	..	196	..	..	..	..	..	..	..
..	133	..	..	..	..	..	146	148	133	146	..	127	..	..	..	150	..	..	..	..	..	150	..	..	..
..	190	..	..	..	..	.	..	..	..	..	..	..	211	..	..	194	..	199	196		193	251	..		185
..	..	..	..	..	..	..	..	..	..	..	..	..		..	..	..	..	..	..	..	..	..	..	..	..
192	190	..	..	..	..	..	..	198	163	225	..	200	..	..	..	199	..	225	..	..	..	..	..	..	..
..	117	..	..	..	..	..	..	..	122	109	..			..	..	..	..	..	..	..	..	..	..	..	..
..	125	..	..	..	..	..	..	135	118	..	..	..	..	..	104	..	130	..	125	..	..	128	..	..	..
..	107	..	..	114	..	120	115	122	111	111	112	114	..	135	111	118	121	117	117	..	..	109	..	149	130
..	56	..		..	..	..	55	..	55	..	..	75		..	..	..	..	.	..	..	..	83	..	..	..

TAB

No.	Plant.	1. Maker.	2. Babbacombe.	3. Totnes.	4. Trusham.	5. Westward Ho.	6. Yeovil.	7. Wincanton.	8. Salisbury.	9. Downside.	10. Strathfield Turgiss.	11. Marlborough.	12. Isleworth.	13. Watford.	14. St. Alban's. R. B.
54	*Mentha aquatica*	..	223	..	205	..	..	213	216	..	..	219	222	..	..
55	*Thymus Serpyllum*	..	175	194	..	167	..	186	169	..	182	157	..	..	..
56	*Prunella vulgaris*	..	182	159	..	154	..	160	174	..	..	163	179	165	171
57	*Nepeta Glechoma*	79	92	..	59	..	75	76	77	79	..	81	88	90	85
58	*Galeopsis Tetrahit*	..	..	..	175	..	..	209	..	197	..	179	..	185	..
59	*Stachys sylvatica*	..	..	..	..	153	..	165	147	..	165	156	165	158	..
60	*Ajuga reptans*	..	118	..	113	..	108	103	101	..	117	114	116	116	129
61	PRIMULA VERIS		94	..	..	..	75	81	85		77	95	108	92	86
62	*Plantago lanceolata*	..	110	..	92	..	103	95	99	..	117	117	116	115	120
63	*Mercurialis perennis*	..	80	..	53	..	65	58	63	58	64	57	79	63	61
64	*Ulmus montana*	55	73	..	59	..	65	74	..	..	..	69	75	..	..
65	*Salix caprea*	35	71	..	71	..	67	86	73	..	..	82	75	70	..
66	*Corylus Avellana*	..	75	..	50	..	49	64	56	.	58	52	56	46	65
67	*Orchis maculata*	..	171	..	..	150	..	..	143	111	..	157	171	..	..
68	*Iris Pseud-acorus*	..	162	145	..	146	..	159	154	..	161	165	163	158	169
69	*Narcissus Pseudo-narcissus*	..	..	..	65	..	72	86	68	..	73	69	86	70	85
70	*Galanthus nivalis*	..	..	..	43	..	56	67	46	58	37	44	51	46	34
71	*Endymion nutans*	98	113	..	103	..	103	106	108	126	116	114	113	116	..

The first change or turn towards autumn tints occurred in the Limes on the 18th of July, and by the 16th some trees over or close by roads were leafless; on the 19th of August some large old Limes overhanging grass were beginning to turn.

The difference in date of defoliation in the Lime this year, according to the trees being in a dry situation or otherwise, has been very noticeable.

On August 15th some Beeches changed slightly.

On September 17th, accompanying a drop in temperature with rainfall, a change began in the leafage of Elms, Birch, Hawthorn and Horse Chestnut, otherwise the change to autumn tint was little advanced by the end of September.

STATE OF FOLIATION FROM ISLEWORTH TO READING ON MAY 24, 1880.

On May 24 the state of leafage between Isleworth and Reading presented a marked contrast to its condition on the same day of May 1879. Then, after a long continuance of low temperature and sunless days with much rainfall, "some species of trees were entirely leafless, others very little advanced;" in the present year, after about five weeks of warmer weather, much sunshine and little rainfall, the trees were for the most part either sprinkled with leafage, or in leaf. Elm was in leaf throughout the distance, the foliage, however, not being full sized.

Oak was lightly sprinkled, or in light leaf, excepting on the Upland Moor,

ntinued.

	18. Sawbridgeworth.	19. Hertford.	20. Hertford.	21. Throcking.	22. Hoddesdon.	23. Berkhampstead.	24. Kimpton.	25. Addington.	26. Bradenham.	27. Oxford.	28. Bocking.	29. Odsey.	30. Cardington.	31. English Bicknor.	32. Cheltenham.	33. Bishop Frome.	34. Uppingham.	35. Hatton.	36. Great Cotes.	37. Farley.	38. Belton.	39. Geldeston.	40. Sparham.	41. Chester.	42. Parbold.	43. Middleton-in-Teesdale.
	217	..	..	..	..	..	..	..	..	..	233		218	..	..	..	..	..	..	..	..	226	..	..	..	..
	..	173	..	..	..	..	..	..	198	153		158	167	179	..	..	..	..	..	176	178	..	..	..	..	..	..
7	..	177	..	..	..	..	..	..	173	163	175	..	171	169	..	..	165	176	..	177	174	..	181	..	..	..
8	..	94	..	..	86	98	..	92	95	96	91	81	90	..	109	82	78	98	104	101	..	..	67	..	..	..
	..	183	..	..	..	..	..	..	..	..	..	..	..	..	..	...	200	..	..	..	..	..	..	..	185	..
8	168	150	..	..	..	..	..	..	162	163	162	..	166	161	..	..	164	171	..	178	173	..	170	..	197	..
1	..	115	..	..	..	..	..	113	130	113	124	..	122	..	..	115	120	123	138	126	..	..	120	..	..	..
1	..	92	..	88	89	..	89	86	98	75	89	86	90	..	..	66	102	100	90	94	109	..	111	..	..	119
1	..	110	..	..	..	..	..	113	..	107	..	..	110	..	..	122	108	127	131	123	..	..	110	..	..	..
4	..	68	..	44	..	..	..	113	63	48	70	..		..	..	66	63	..	....	81	..	..	74	53	100	78
	..	64	..	..	..	..	..	75	..	66	66	..	78	..	..		..	69	..	70	..	..	..	..	..	..
1	..	55	..	75	56	..	..	88	71	64	69	..	78	..	61		72	..	85	75	..	..	75	..	..	78
8	..	48	..	..	..	..	..	67	63	42	51	..	61	..	..	65	56	..	73	75	..	..	53	56	87	44
5	..	153	..	..	..	..	..	124	150	155	..	..	..	160	136	149	158	..	163	169	165	..	170	..	..	155
1	..	152	..	..	..	..	..	..		149	179	..	178	159	..	..	..	..	159	..	161	..	177	..	..	..
3	..	62	..	88	75	..	..	81	..	75		73	88	..	..	..	..	..	98	114	..	..	65	..	60	..
8	..	45	..	48	..	..	..	49	..	48	49	48	41	..	..	..	49	49	45	55	..	..	44	..	60	46
5	..	118	..	..	..	116	122	..	125	107	..	124		..	109	116	117	125	116	133	..	..	124	128	..	119

between Ascot and Bracknell, where the trees were totally leafless, some, however, in the shelter of a wood near being lightly sprinkled. It was also noticeable that Oaks in arable land were generally later than those with grass beneath them; this (conjecturally) from the drier air from the ground not being as favourable as the moisture in grass for development of foliage.

The Lime and Horse Chestnut trees standing alternately (between Feltham and Ashford) were exactly similarly advanced in leafage; last year the Horse Chestnuts were in advance.

These two species, and also Sycamore, Beech, Birch, Willow and Lombardy Poplar, were in leaf.

The Hawthorn hedges were in good leaf. Pear in leaf, and Apple in moderate leaf, but at times with the ends of the shoots blasted as if with the winter cold.

Alder and Walnuts had only a sprinkling of leaves, and the Ash trees hardly advanced to this amount; some trees were just showing leafage, some slightly sprinkled. The Ash foliage was clearly much later than that of the Oak.

Larch was in healthy leaf, and Pine, or Scotch Fir, and Spruce were shooting well; as far as could be estimated in passing, the Pine shoot was up to seven inches, the Spruce shoot up to two to three inches in length.

The foliage was generally healthy, and in a very similar state of advance throughout the distance from Isleworth to Reading; the flowering plants were more advanced near Reading than near Isleworth.

TABLE II.

No. and Name of Plant.	Years.	6. Yeovil.	8. Salisbury.	10. Strathfield Turgiss.	11. Marlborough.	12. Isleworth.	18. Watford.	17. Ware.	30. Cardington.	33. Bishop Frome.	36. Great Coten.	Average.
70. *Galanthus nivalis* (Snowdrop)	1875	26	..	2	15	..	..	..	..	..	..	14
	1876	36	..	31	30	30	..	..	28	..	32	31
	1877	23	16	18	21	19	..	..	11	..	20	18
	1878	26	17	32	29	44	..	23	20	n	31	28
	1879	43	35	36	40	46	37	43	36	..	52	41
	1880	56	46	37	44	51	46	48	41	49	45	46
66. *Corylus Avellana* (Hazel)	1875	16	..	5	18	..	..	..	..	..	..	13
	1876	28	..	6	23	..	..	..	29	36	..	24
	1877	9	2	9	15	28	..	..	15	9	..	12
	1878	27	21	43	39	23	47	25	41	50	..	34
	1879	31	17	37	41	43	46	51	42	50	n	39
	1880	49	56	58	52	56	53	58	61	65	73	57
2. RANUNCULUS FICARIA (Pilewort)..	1875	16	..	40	32	95	..	..	95	..	89	61
	1876	50	..	39	46	62	85	81	50	52	73	57
	1877	9	20	..	19	50	..	38	39	43	67	36
	1878	15	21	50	18	49	59	52	42	32	n	35
	1879	63	66	72	60	88	75	74	94	65	77	73
	1880	57	63	..	51	70	61	71	66	66	66	64
63. *Mercurialis perennis* (Dog's Mercury)	1875	30	..	..	64	..	..	..	..	..	..	47
	1876	53	..	74	60	..	85	..	55	59	98	69
	1877	37	15	40	25	..	..	38	36	34	..	32
	1878	49	31	..	31	69	47	51	43	50	75	50
	1879	67	65	70	69	79	89	87	106	95	..	80
	1880	65	63	64	57	79	63	64	..	66	...	65
37. TUSSILAGO FARFARA (Coltsfoot)..	1875	74	..	..	69	..	..	..	..	..	74	72
	1876	53	..	52	60	74	70	..	57	53	73	62
	1877	45	80	..	45	52	..	38	42	64	45	51
	1878	49	61	65	48	55	..	52	47	48	49	53
	1879	63	65	69	61	68	n	60	65	66	78	66
	1880	57	65	65	42	70	59	59	61	65	63	61
25. *Potentilla Fragariastrum* (Barren Strawberry)	1875	..	..	27	64	..	..	..	..	..	..	46
	1876	36	..	54	59	..	75	79	69	..	..	60
	1877	all yr.	46	19	42	81	..	..	50	35	98	53
	1878	all yr.	n	45	21	80	65	74	54	51	76	50
	1879	43	56	79	66	101	75	128	98	n	..	82
	1880	64	59	43	59	100	75	92	..	66	..	69
9. *Viola odorata* (Sweet Violet) ..	1875	28	..	23	72	..	..	..	..	..	68	48
	1876	39	..	8	62	36	71	..	62	60	64	50
	1877	41	45	4	56	75	..	..	49	50	48	46
	1878	51	61	56	61	70	63	..	57	28	n	56
	1879	69	70	60	75	n	..	..	n	70	73	70
	1880	56	65	49	67	75	70	72	66	..	64	64
65. *Salix caprea* (Great Sallow) ..	1875	69	..	65	73	..	..	..	91	..	..	75
	1876	63	..	..	61	..	..	..	83	..	71	70
	1877	47	n	..	48	..	..	..	50	n	86	58
	1878	63	59	..	67	..	63	63	62	61	70	64
	1879	69	78	..	76	80	75	74	91	78	101	81
	1880	67	73	..	82	75	70	71	78	..	85	76
69. *Narcissus Pseudo-narcissus* (Daffodil)	1875	93	..	..	69	..	..	..	..	..	..	81
	1876	70	..	67	60	74	..	..	75	78	..	61
	1877	65	..	55	45	65	.	72	74	..	..	54
	1878	64	..	60	48	60	68	60	72	68	..	54
	1879	77	70	81	75	80	89	..	97	..	100	84
	1880	72	68	73	69	86	70	73	88	..	98	78
64. *Ulmus montana* (Wych Elm)	1875	69	..	..	68	.	..	..	..	..	..	69
	1876	59	..	..	59	71	..	..	67	..	..	64
	1877	45	..	..	58	54	..	..	56	..	..	53
	1878	56	..	..	57	58	..	..	67	88	..	65
	1879	72	..	..	79	79	..	..	89	..	..	80
	1880	65	..	..	69	75	..	..	78	..	..	72

TABLE II.—*Continued.*

. and Name of Plant.	Year.	6. Yeovil.	8. Salisbury.	10. Strathfield Turgiss.	11. Marlborough.	12. Isleworth.	13. Watford.	17. Ware.	30. Cardington.	33. Bishop Frome.	36. Great Cotes.	Average.
	1875	..	..	..	73	..	..	..	95	..	..	64
	1876	..	..	..	58	68	..	..	53	..	..	60
'aba verna	1877	all yr.	35	..	49	39	..	..	27	..	..	38
ıitlow Grass)	1878	all yr.	24	..	48	61	..	..	48	..	..	45
	1879	18	64	98	115	74	..	..	64	..	103	77
	1880	42	54	93	66	65	..	..	85	95	..	71
	1875	92	..	80	76	..	..	..	94	..	94	87
	1876	77	..	84	62	91	81	83	88	68	92	81
ıEMONE NEMO-	1877	62	72	74	73	85	..	83	86	76	91	78
. (Wood Ane-	1878	63	60	70	55	77	..	67	72	61	..	66
ıe)	1879	78	77	95	78	91	93	87	93	93	97	88
	1880	72	71	71	61	86	81	73	70	73	96	75
	1875	76	..	..	86	..	..	..	115	..	102	95
	1876	40	..	74	59	90	..	91	94	..	67	74
LTHA PALUS-	1877	40	55	47	45	90	..	89	49	67	89	63
(Marsh Mari-	1878	47	n	70	50	66	..	80	60	71	55	62
)	1879	56	79	93	65	105	..	97	97	..	79	84
	1880	58	76	89	59	104	64	108	93	85	82	84
	1875	88	..	..	92	..	..	..	117	..	104	100
	1876	76	..	90	92	98	97	90	95	95	103	92
ıpeta Glechoma	1877	69	75	..	102	101	..	..	93	98	102	91
ıund Ivy) ...	1878	73	63	..	66	88	81	78	76	78	68	74
	1879	87	91	96	98	101	109	107	108	..	114	101
	1880	75	77	..	81	88	90	88	90	82	104	86
	1875	90	..	89	102	106	..	..	106	..	..	99
	1876	95	..	95	97	95	97	97	94	102	99	97
ıUNUS SPINOSA	1877	65	36	..	83	62	..	55	48	92	92	67
ckthorn)	1878	72	70	77	72	90	..	75	76	95	90	80
	1879	114	91	118	125	115	123	118	118	124	131	117
	1880	89	80	99	109	101	94	97	95	108	110	99
	1875	92	..	91	109	..	..	..	100	..	102	99
	1876	85	..	94	107	115	78	89	97	91	96	97
ıIMULA VERIS	1877	90	88	..	97	107	..	73	94	62	87	87
vslip)	1878	81	96	68	102	97	80	78	86	71	83	85
	1879	98	..	..	116	114	103	107	104	114	118	110
	1880	75	85	77	95	108	92	91	90	66	90	86
	1875	33	..	..	88	97	..	..	125	..	..	86
	1876	77	..	..	117	108	..	111	118	..	..	106
thriscus sylves-	1877	40	96	114	91	99	119	105	104	112	..	95
(Cow Chervil)	1878	74	63	..	18	109	97	..	60	104	115	78
	1879	114	135	..	125	132	124	128	114	..	141	127
	1880	98	90	108	88	112	108	108	113	142	128	110
	1875	91	..	104	116	..	..	..	115	..	114	108
	1876	99	..	106	96	115	111	106	112	111	109	107
ırdamine pra-	1877	73	92	103	91	90	..	103	104	108	102	96
s (Cuckoo-	1878	77	67	86	76	96	97	98	96	102	89	88
er)	1879	109	..	123	116	108	124	116	124	125	130	119
	1880	89	87	97	99	104	102	115	99	96	106	99
	1875	..	..	105	109	..	..	..	127	103	..	111
	1876	95	..	102	107	91	111	95	118	..	113	103
llaria Holostea	1877	45	82	79	85	86	98	88	113	73	98	84
ıater Stitch-	1878	82	85	102	95	94	83	100	105	105	105	97
)	1879	111	..	124	126	120	..	128	142	119	134	126
	1880	94	94	110	98	108	107	110	114	108	118	106
	1875	113	..	114	98	..	..	..	..	..	114	110
	1876	119	..	111	107	111	114	..	116	118	113	114
ndymion nu-	1877	99	99	108	100	107	112	..	113	120	123	109
(Blue-bell) ..	1878	101	99	98	102	104	112	112	..	109	114	105
	1879	119	135	123	125	132	138	144	132	..	142	132
	1880	103	108	116	114	113	116	115	..	116	116	113

TABLE II.—*Continued.*

No. and Name of Plant.	Years.	6. Yeovil.	8. Salisbury.	10. Strathfield Turgiss.	11. Marlborough.	12. Isleworth.	13. Watford.	17. Ware.	30. Cardington.	33. Bishop Frome.	36. Great Oates.	Average.
52. *Veronica Chamædrys* (Germander Speedwell)	1875	89	..	..	109	..	..	..	129	..	..	109
	1876	94	..	..	124	107	125	123	123	123	..	116
	1877	76	97	78	114	111	112	..	121	122	..	104
	1878	74	65	47	90	102	114	115	106	115	n	89
	1879	114	..	63	129	132	138	..	133	..	142	122
	1880	93	85	59	114	113	110	110	114	111	117	102
62. *Plantago lanceolata* (Ribwort Plantain)	1875	109	..	..	121	..	..	..	123	..	..	118
	1876	99	..	..	117	115	..	105	112	..	..	110
	1877	99	..	..	114	120	..	114	111	..	..	112
	1878	99	..	105	103	114	114	..	108	127	134	113
	1879	118	..	127	125	132	138	144	124	..	149	131
	1880	103	99	117	117	116	115	111	110	122	131	114
3. *Ranunculus acris* (Upright Crowfoot)	1875	119	..	..	90	..	..	..	131	..	137	119
	1876	120	..	..	105	115	..	..	116	..	..	114
	1877	120	111	..	114	116	..	..	47	137	137	112
	1878	109	105	108	79	112	..	..	47	118	121	100
	1879	129	139	..	124	133	131	..	136	155	147	137
	1880	113	107	..	103	108	..	128	112	..	119	113
60. *Ajuga reptans* (Bugle)	1875	115	..	123	130	137	..	..	128	..	..	127
	1876	120	..	..	107	126	133	128	125	125	..	122
	1877	103	n	..	128	133	131	123	132	124	144	127
	1878	108	110	..	117	122	118	120	121	n	136	119
	1879	126	..	..	138	139	143	..	140	..	147	139
	1880	108	101	117	114	116	116	121	122	115	138	117
16. Geranium Robertianum (Herb Robert)	1875	113	..	124	116	..	..	..	140	..	133	125
	1876	120	..	114	125	131	121	128	124	133	133	126
	1877	131	120	42	139	141	140	109	144	140	151	124
	1878	112	112	111	116	132	118	121	126	127	124	120
	1879	135	146	139	145	141	140	..	150	..	151	143
	1880	114	119	111	114	146	115	111	124	108	131	120
32. *Galium Aparine* (Cleavers)	1875	..	..	..	123	..	..	..	133	..	..	128
	1876	127	168	..	139	146	146	152	137	..	155	146
	1877	132	151	n	135	145	147	147	144	..	156	144
	1878	123	142	128	124	132	132	137	126	..	162	134
	1879	..	155	156	149	149	145	158	148	..	168	155
	1880	..	..	149	129	143	144	129	130	152	162	142
17. Trifolium repens (Dutch Clover)	1875	133	..	122	135	..	..	..	160	..	..	138
	1876	..	..	135	149	152	..	150	152	146	157	149
	1877	138	163	..	153	161	153	..	159	149	..	154
	1878	120	143	126	134	134	129	144	138	..	161	138
	1879	..	153	154	167	157	152	163	163	..	175	162
	1880	..	140	149	144	146	136	144	144	141	168	147
24. *Potentilla anserina* (Silver-weed)	1875	..	..	..	133	..	..	..	158	..	..	146
	1876	132	..	143	139	142	..	143	145	162	152	145
	1877	141	147	..	146	163	158	..	145	172	153	152
	1878	116	127	..	129	137	138	136	134	..	138	131
	1879	..	146	150	149	145	154	148	152	..	166	151
	1880	104	120	135	127	122	139	128	128	142	148	128
18. *Lotus corniculatus* (Bird's-foot)..	1875	..	..	137	136	..	..	..	157	..	..	141
	1876	134	154	150	148	162	153	146	151	155	..	151
	1877	145	158	..	156	156	162	..	158	159	163	157
	1878	134	134	..	132	139	135	151	138	..	141	136
	1879	..	155	..	155	156	158	179	161	169	166	160
	1880	..	124	..	137	144	146	145	152	138	161	143
39. *Chrysanthemum Leucanthemum* (Ox-eye)	1875	..	..	134	136	..	..	..	140	..	..	137
	1876	..	..	133	148	141	149	152	136	148	..	143
	1877	139	152	132	158	152	151	..	134	157	..	141
	1878	109	124	121	136	127	135	140	121	n	162	130
	1879	140	153	150	159	n	156	..	150	161	173	155
	1880	115	129	135	138	146	130	150	125	138	156	137

TABLE II.—*Continued.*

No. and Name of Plant.	Years.	6. Yeovil.	8. Salisbury.	10. Strathfield Turgiss.	11. Marlborough.	12. Isleworth.	13. Watford.	17. Ware.	30. Cardington.	33. Bishop Frome.	36. Great Cotes.	Average.
46. *Hieracium Pilosella* (Mouse-ear Hawkweed).....	1875	..	..	..	134	..	..	..	148	..	..	141
	1876	..	144	..	146	144	..	142	139	142	..	143
	1877	138	144	..	135	150	154	..	148	..	..	145
	1878	123	124	..	132	134	141	..	130	..	..	131
	1879	..	146	..	159	169	..	..	151	170	..	159
	1880	..	124	..	139	151	137	..	127	..	..	136
11. *Lychnis Flos-cuculi* (Ragged Robin)	1875	..	..	..	140	..	..	..	143	..	129	137
	1876	..	156	153	158	154	154	145	152	159	150	153
	1877	150	155	145	161	153	162	..	159	160	156	156
	1878	137	134	134	134	137	148	..	139	145	143	139
	1879	..	160	162	168	n	165	..	161	169	162	164
	1880	..	140	142	157	144	132	..	151	..	156	146
21. *Lathyrus pratensis* (Meadow Vetchling).....	1875	..	..	..	147	..	..	..	..	..	161	154
	1876	..	174	158	162	162	..	164	165	..	..	164
	1877	..	167	..	167	166	164	..	165	..	172	167
	1878	156	155	..	157	160	150	..	161	..	161	157
	1879	..	163	..	166	179	182	168	171	169	167	169
	1880	..	138	..	151	148	..	165	157	..	160	153
5. *Papaver Rhœas* (Red Poppy)	1875	..	..	..	141	..	..	..	144	..	..	145
	1876	..	..	163	165	163	154	160	159	..	..	152
	1877	159	151	..	166	157	160	..	164	..	..	160
	1878	134	156	172	157	146	146	151	155	..	161	154
	1879	..	176	176	179	n	..	170	175	..	172	175
	1880	..	162	170	170	172	..	165	157	..	173	167
68. *Iris Pseud-acorus* (Yellow Iris)....	1875	..	..	154	150	159	..	..	..	..	162	156
	1876	..	153	171	156	164	162	160	167	167	169	163
	1877	..	..	..	165	165	163	..	172	..	166	166
	1878	..	138	152	141	152	145	145	153	..	153	148
	1879	..	160	177	167	177	170	165	171	..	169	169
	1880	..	154	161	165	163	158	151	178	..	159	162
26. *Rosa canina* (Dog Rose)	1875	..	..	..	150	160	..	..	160	..	157	157
	1876	..	160	164	165	165	163	164	161	165	167	164
	1877	..	165	160	164	166	164	..	165	166	172	165
	1878	154	154	133	151	151	146	150	158	150	154	151
	1879	..	171	173	182	180	171	177	177	180	187	178
	1880	..	159	153	150	165	161	165	166	..	173	162
13. MALVA SYLVESTRIS (Common Mallow)	1875	..	..	164	156	..	..	..	156	..	154	158
	1876	..	..	164	171	163	162	161	170	186	169	169
	1877	..	166	172	165	163	168	..	167	179	172	169
	1878	157	156	175	161	153	150	154	163	..	161	160
	1879	..	175	190	175	n	182	184	176	..	179	180
	1880	..	164	193	161	172	146	157	162	..	170	168
59. *Stachys sylvatica* (Hedge Woundwort)	1875	..	..	169	160	..	..	..	164	..	..	164
	1876	..	n	168	171	176	170	161	166	176	..	170
	1877	..	169	..	173	168	..	..	169	172	..	170
	1878	154	153	..	157	146	153	145	157	165	..	154
	1879	..	171	..	179	179	173	170	177	181	..	176
	1880	..	147	165	156	165	158	158	166	..	..	160
28. *Epilobium montanum* (Broad Willow-herb)	1875	..	..	161	163	..	..	..	175	..	..	166
	1876	..	175	163	173	..	..	..	178	187	..	175
	1877	..	177	..	165	167	168	..	170	174	..	170
	1878	159	..	176	161	166	..	..	161	..	..	165
	1879	..	175	..	178	171	180	..	177	..	..	176
	1880	..	171	..	170	162	166	..	170	138	..	163
23. *Spiræa Ulmaria* (Meadow-sweet)	1875	..	..	174	168	..	..	..	173	..	176	173
	1876	..	173	170	176	182	182	175	181	178	..	176
	1877	..	169	173	173	175	..	..	175	172	183	174
	1878	159	161	170	168	172	173	..	169	165	172	168
	1879	..	180	188	182	196	193	.	186	189	189	188
	1880	..	167	183	166	176	176	184	172	..	182	176

TABLE II.—*Continued.*

No. and Name of Plant.	Years.	6. Yeovil.	8. Salisbury.	10. Strathfield Turgiss.	11. Marlborough.	12. Isleworth.	13. Watford.	17. Ware.	30. Cardington.	33. Bishop Frome.	36. Great Cotes.	Average.
42. CENTAUREA NIGRA (Black Knapweed)	1875	..	..	169	158	..	..	..	158	..	..	162
	1876	..	181	..	181	178	..	178	168	179	189	179
	1877	..	177	..	179	175	..	..	172	178	190	178
	1878	165	..	171	180	152	167	..	166	169	173	168
	1879	..	n	182	204	179	..	..	185	n	195	189
	1880	..	171	173	176	172	180	177	172	..	179	175
33. *Galium verum* (Yellow Bedstraw)	1875	..	..	177	175	..	..	..	176	..	..	176
	1876	..	180	198	179	185	..	182	179	190	..	185
	1877	..	181	..	178	183	..	..	180	..	190	182
	1878	..	..	..	179	191	180	..	173	188	185	183
	1879	..	188	..	195	197	199	..	196	202	196	196
	1880	..	175	..	182	192	185	..	183	..	195	185
44. *Carduus arvensis* (Field Thistle) ..	1875	..	..	170	177	187	..	..	177	..	181	178
	1876	..	185	..	187	187	183	183	188	168	174	182
	1877	..	181	..	185	184	..	..	187	..	178	183
	1878	170	..	..	180	177	..	..	182	..	172	176
	1879	..	199	..	203	203	..	..	198	..	205	202
	1880	..	173	..	191	187	..	165	184	..	197	183
45. *Sonchus arvensis* (Corn Sow-Thistle)	1875	..	..	213	191	..	..	..	169	..	..	191
	1876	..	..	209	187	186	..	..	192	..	191	193
	1877	..	..	226	206	201	..	..	195	..	199	205
	1878	..	..	246	190	183	..	..	180	..	..	200
	1879	..	n	..	214	211	214	..	215	..	200	211
	1880	..	205	..	210	192	..	..	199	..	196	200
49. CONVOLVULUS SEPIUM (Greater Bindweed)	1875	..	..	187	191	212	..	..	..	..	188	195
	1876	..	199	184	193	187	..	..	198	..	211	195
	1877	..	188	199	206	185	..	..	198	..	218	199
	1878	..	..	166	195	182	..	..	191	..	211	189
	1879	..	210	194	222	197	..	..	213	..	235	212
	1880	..	191	176	201	187	164	184	200	..	225	194

Beginning at the easterly end, the Gorse near Feltham was in bloom, and also the Hawthorn, and some Ox Eye Daisies in southerly exposure.

Between Staines and Egham Hawthorn blossom was partially fading.

Near Virginia Water the Ox Eye Daisies were noticeable on both northerly and southerly exposures.

Near Sunningdale Broom and Wild Hyacinths were noticeable, and between Sunningdale and Ascot the Broom was in luxuriant blossom.

Between Ascot and Bracknell the pink Ragged Robin appeared with the Wild Hyacinth, and between Wokingham and Reading much greater variety of wild flowers was observable.

Some blossom still remained on the Hawthorn. Chervil was luxuriantly in blossom, and Cowslips, Purple Clover, Bird's Foot Trefoil, Red Poppy and the Greater Stitchwort were in flower on the railway banks.

The Heath on the Moorlands near Ascot was shooting well, and in some cases was already green with the new leafage; Oak Apples were clearly observable, and the Bracken Fern was frequently plentiful, and sometimes from one to two feet high.

Buttercups and Sorrel were remarkably plentiful, and in the neighbourhood of Ascot flower was showing on the Scotch Firs.

The crops, generally, appeared to be suffering from drought.

Some luxuriant herbage was noticeable in low meadows between Staines and Egham, and some Clover also was good; between Egham and Virginia Water there was a little good Wheat and fair Clover, but, generally, the corn crops were poor, and also such Pea and Bean crops as were noticeable; the Hay was backward and thin, and the pasture land unusually bare.

The second or summer shoot was first noticeable on the Elms on June 5th; on the Limes on July 16th.

The diagram on Plate II. is a first approximation towards seeing how far temperature acts upon vegetation as a whole. It comprises the results of observations upon about 450 plants, cultivated and wild, for the 15 years previous to 1880, with a comparison of the dates of flowering for the present year. The central line is taken as a base line, from which the variations from the average time of flowering are reckoned. In the bottom line are given the variations of temperature from the mean for each week, as given in the "Agricultural Statistics of the Weather."

Each of the spaces above and below the central line is taken to indicate a time of 12 days; when the date of flowering for 1880 is *later* than the mean, a black line is carried over the spaces *above* the central line to the proper distance, and when *earlier*, a shaded line *below* the base line is used.

Thus the Winter Aconite (*Eranthys hiemalis*) usually appears on January 25; this year it was 14 days later, consequently a black line is carried through $1\frac{1}{6}$ spaces *above* the central line. Again, February 23rd is the average date for the Coltsfoot (*Tussilago Farfara*); a *shaded* line is carried over 1 space *below* the central line to indicate that this year it was 12 days before the mean.

When the average date of flowering is the same for *several* plants, the mean of the variations is indicated. Thus June 9th is the average date for six flowers, 4 of which were 13, 11, 5 and 1 days respectively later, and 2 were 5 and 12 days earlier than this average. The mean of all these indicates an average date of 2 days late, consequently a black line is carried a little above the base line.

It is evident, therefore, that, with one exception, plants were later than their average till March 8th, when they began to get earlier, and, as a rule, continued so till the middle of April. A curious retardation then took place for a week, but after this to the end of the month plants were early. During the first week in May there was a struggle between the early and late flowers, and after that they continued almost uniformly later than the mean.

Referring now to the temperature line, we see as a rule that when plants were *late* the temperature was above the mean and *vice versâ* till May, when the uniformly low temperature caused a corresponding retardation in flowering. It seems, therefore, as far as this diagram proves anything, that it takes some time for temperature to act on vegetation. During February and March there

was a period of five weeks of warm weather (or of weather very slightly below the mean) before plants were affected. The warm weather lasted one more week, and it then turned cold (one week alone at the beginning of April being rather warmer than usual) and continued so for some months; and yet plants, as a rule, were earlier than usual, resulting, as I think, from the previous warm period; the late week in the middle of April being due to the cold fortnight at the end of March.

I cannot trace any effect upon particular *classes* of plants, *i.e.* whether acquatic plants were more affected than land plants, or trees than herbs, but consider this diagram to represent the effects of temperature *as a whole*. This may be more exemplified by examining a few of the "divergencies" from uniformity in the diagram.

One plant alone up to March 7th was before its usual date; this was the Coltsfoot (*T. Farfara*). I am inclined to think that this results from the field having been ploughed up, and thus having brought the roots more under the influence of the warm weather which prevailed at this time. The specimen was brought to me, and I was told that "several more were in the same field"; consequently it was duly entered according to our rule. The next *notice* that I have is 2 days later than the mean. It is *possible*, therefore, that this "early flowering" may be the result of accident.

The late date, again, on March 10th is that of the common Elm (*U. tuberosa*), that on March 30th is the combined results of the Cow Chervil (*Anthriscus sylvestris*) and of the Sloe (*Prunus spinosa*), one a deep rooted and the other possibly a shallow rooted plant; whilst the late period in the middle of April embraces results from acquatic plants, trees, grasses, bulbous plants, herbaceous plants and woodland plants. It will require, therefore, very many more observations before we can hope to get any reliable results in these matters.

Notes on the Several Species.

1. Anemone nemorosa. **19.** "full bloom," March 28; **32.** "common" April 16; **35.** "great many as forward as specimen sent," March 30; **37.** "full," April 8; **40.** "seems to have been in bloom several days at Hockering," May 4; **41.** "full at Gresford," March 22. Specimens from **12, 16, 17** were decidedly advanced, that from **13** rather so. Remarkably late at **7** and **25**, and very early at **19**.

2. Ranunculus Ficaria. **11.** Specimen seen February 11; **23**, April 7; **35.** one specimen March 7, next seen March 17 (several); **40.** "several," February 19. Very late at **2** and **37**, and early at **15, 40** and **43.**

3. *Ranunculus acris.* **2.** by May 21; **11.** specimen seen March 22; **12.** "flowers remarkably small;" **19.** "buds much retarded by cold winds;" **40.** "at Foxley, January 9, at Sparham, January 2-9." This species is still much confused with the Goldilocks (*R. auricomus*). Many of the first flowers were very small, but afterwards attained their full size; some were

even "unusually large." Very late at **2**, **9**, and **38**; the specimens sent were very fine. Late also at **9**.

4. CALTHA PALUSTRIS. **4.** "by" April 1, "2 or 3 days;" **8.** "very scarce all March;" **9.** "in numbers," March 22, flowers very large this year; **36.** "recorded as first flowering March 22," "most abundant in April;" **37.** "first in full flower at Oakamoor," April 7; **40.** "one flower" January 31; **41.** "full at Gresford" March 22. Very early at **6** and **11**, and remarkably late at the Devonshire Stations. There is a great variation in the dates. It appears to have come into flower very slowly.

5. *Papaver Rhœas*. **2.** "by" June 23; **3.** "several" June 7; **8.** "several by" June 12; **12.** "unusually abundant;" very late at **2**. Of the specimens sent from 10 localities, no less than 4 were those of either *P. dubium* or *P. Argemone*. It seems curious that the well-marked feature of the spreading hairs on the stem should be so frequently overlooked.

6. *Cardamine hirsuta*. **4.** "by" February 11, "flower and young fruit;" **13.** "in seed" April 6; **19.** "full flower, but plants stunted," March 10. Very late at **2**, **23**, and **25**, and early at **6** and **7**. The specimens sent show a very fairly equal state of flowering, that from **13** alone being rather too advanced.

7. *Cardamine pratensis*. **4.** "by" April 8, "flower 2 or 3 days old;" **9.** "great numbers" March 24, flower very large; **25.** "a most wonderful quantity of it later on, meadows a perfect sheet of flowers;" **27.** "by a few days," April 11; **32.** "abundant" April 22; **34.** "at least 2 days," April 11; **36.** "this year in the utmost profusion;" **37.** "full bud" April 18; "well in flower" April 23. The specimens seem very satisfactory, that from **4** being slightly more advanced than the others.

8. *Draba verna*. **6.** "possibly in January;" **9.** "very fine specimens in great numbers," March 11; "very few seeds, probably on account of the scarcity of insects;" **12.** "very scarce;" **16.** "flower and seed," April 20; **34.** "flower and seed," February 22; **40.** "in bloom several days," March 14. Too late at **10** and **19**. The specimens from **16** and **35** are far too advanced. There is too great a variety in the dates to deduce any results.

9. *Viola odorata*. **8.** "lasted hardly 3 weeks;" **9.** "very fine flowers and very large;" **34.** March 4, and next March 9; **35.** cultivated specimen March 13; **37.** "white *well* in flower" March 25. Very early at **10** and **41**, probably cultivated specimens.

10. *Polygala vulgaris*. **4.** "*depressa* by May 4," "2 or 3 days;" **12.** "flowers and seed," June 19. Specimens from **33** rather advanced. Remarkably late at **16** and **36**.

11. *Lychnis Flos-cuculi*. **9.** "this year few flowers, bad specimens;" **11.** specimen seen May 29; **14.** specimen sent rather advanced; **25.** "Ragged Robin in flower," May 20; **31.** "not plentiful yet," June 22. The date for **31** appears late, but the specimens are in their proper condition. Very late at **37**, and *very* early at **40**.

12. *Stellaria Holostea.* 9. "very few flowers this year;" 12. "flowers rather undersized, not as beautiful as usual;" 37. "becoming general" April 25; 41. "abundant at Bagillt May 7."

13. MALVA SYLVESTRIS. 3. "several observed" June 20; 8. near Wishford, June 10; Hannington, June 28; very late at 10 and 12; very early at 14. Specimens from 28 and 31 very advanced, and the dates have consequently been entered here and not in the Table; 28. June 29; 31. July 5.

14. *Hypericum tetrapterum.* Two of the specimens sent were of other species.

15. *Hypericum pulchrum.* 8. June 28, "already in seed, not in flower on 19." This also is occasionally confused with other species of Hypericum.

16. GERANIUM ROBERTIANUM. 1. April 3, "about average date;" 9. "very large and plentiful, but little in flower," June 28; 26. "one plant April 21." Very late at 12 and 16.

17. TRIFOLIUM REPENS. 4. "must have been in flower some days, by May 10;" 9. "few specimens" June 29; 10. "white Clover" May 28; 14. "by" May 24; 25. "Dutch Clover, in flower May 25." Specimens from 2 and 28 rather advanced.

18. *Lotus corniculatus.* 2. July 14, too late date; 3. "by" May 14; 4. Teign Valley "by" May 7; 9. "numberless" May 18; 25. "full flower late," June 28; 34. May 29, "date back at least 2 days." Specimens from 31 a little advanced.

19. *Vicia Cracca.* 4. "by" June 28, "open several days;" 10. said to have flowered on April 20, probably mistaken for Vicia Sepium. 16. July 18, too late.

20. *Vicia sepium.* 4. "by" April 16; 9. May 18, date evidently too late; 37. Farley, May 16; Cheadle, May 14. Specimens from 14 and 28 a little advanced. Very late at Belton.

21. *Lathyrus pratensis.* 26. June 26, very late.

22. PRUNUS SPINOSA. 8. "very slow in coming into flower," May 8, too late date; Malden (Essex) April 12; 13. "perhaps a week," April 10; 17. "no blackthorn," April 29; 22. "fully in bloom," April 15; 32. "in full flower," April 28; 34. "one flower on April 8," 42. "probably 10 days in flower," May 7.

23. *Spiræa Ulmaria.* 3. "several observed" June 15; 4. "by June 28, open several days;" 8. between Hannington and Swindon, June 10; 17. "by" July 5, specimen rather advanced; 25. "full flower" June 28; 31. "only one specimen," June 27; 35. "fully out" June 28; 37. Farley, July 7; Churnet Valley, July 5; very late at 10.

24. *Potentilla anserina.* 3. "by" May 14; very late at 2.

25. *Potentilla Fragariastrum.* 1. June 20, "usual date June 9"; 4. "by June 9; several with petals fallen or wanting in one spot, scarcely in bud elsewhere"; 12. specimen seen March 25; 13. "in numbers March 17, where none were seen on 13"; 15. "very abundant" March 28; 34. March 10, "date back 1 day;" 37. "in flower" March 21; 40. "plenty

in full bloom," March 21; 41. at Gresford, February 22; 42. April 2, specimen rather advanced; very late at 2, 7 and 9 (May 18), which is evidently too late a date. The dates show extreme variations, from which it is impossible to draw any satisfactory conclusions.

26. *Rosa canina.* 3. "several observed," June 8; 8. "on several bushes," June 11; Hannington, June 8; 9. "dwarfed," July 5; 13. "only one flower seen" June 9; 34. "several," June 6; "first seen" June 1; 37. "first seen in full flower" June 22.

27. *Epilobium hirsutum.* Specimens sent all indicating very fine growth, that from 37 being the only one at all advanced, and that very slightly.

28. *Epilobium montanum.* 4. "by" June 19; 8. June 19, "2 plants had first flower in seed, none open on 12;" 11. specimen seen June 10; 14. "flower and seed," June 23. Specimen from 14 very much advanced, that from 33 rather so, though the date is remarkably early; very early at 19.

29. *Angelica sylvestris.* 4. "by July 31; must have been in flower several days."

30. *Anthriscus sylvestris.* Very late at 10 and 33, and early at 27.

31. *Hedera Helix.* 1. September 6, "2 or 3 days late;" 11. "about a week," September 20; 12. October 9, 1879, "not luxuriant," September 8, 1880; 39. "fully out in some trees," September 24; "pretty generally out" September 29.

32. *Galium Aparine.* 8. "seed June 1;" 26. June 26, "in flower some time;" very late at 25 and 32.

33. *Galium verum.* 8. "a good deal of open flower," June 30; 9. August 12; 12. "coloured bud July 5, in flower July 12; 25. "full" July 6.

35. *Scabiosa succisa.* 4. "by July 31; must have been in flower several days;" 9. "scarce August 6;" 43. "by" August 5.

36. *Petasites vulgaris.* 11. Specimen seen February 20; 19. "sparingly," March 18; 36. "about" April 2; 37. "first full flower" April 18; 41. "full at Gresford," March 22.

37. TUSSILAGO FARFARA. 2. "by" March 18, very late; specimen rather advanced; 9. March 5, "saw very few flowers this year;" 12. "moderately plentiful" March 10; 19. "by" March 1, "perhaps nine days;" 28. specimen sent a little advanced; 33. "much found," March 5; 37. "seen on March 7, in flower March 24;" 41. at Gresford, February 22; specimens from 16 and 42 rather advanced; remarkably early at 43.

38. ACHILLEA MILLEFOLIUM. 8. June 19, "very few up to 30;" 11. specimen seen June 6; 19. June 4, very early; 37. "reported," July 5; very late at 14.

39. *Chrysanthemum Leucanthemum.* 2. "by" May 17; 9. August 1; 13. "in profusion on the railway banks," May 23.

40. *Artemisia vulgaris.* 4. "by July 24; must have been in flower several days;" 11. "cultivated specimen observed."

41. *Senecio Jacobæa.* 4. "by" June 23; ray flowers only open;" 34. July 8, "date back 2 days;" 35. "full," June 23.

42. CENTAUREA NIGRA. **4.** "by June 23; several heads fully open;" **43.** "by" August 5.

43. *Carduus lanceolatus.* **43.** "by" August 5; 2 specimens, out of 4 sent, wrongly named.

44. *Carduus arvensis.* **8.** "first flower in seed, several heads open," June 28.

45. *Sonchus arvensis.* **12.** "many plants, but still first flower," July 10.

46. *Hieracium Pilosella.* **34.** May 29, "date back at least 2 days."

47. CAMPANULA ROTUNDIFOLIA. **11.** specimen seen June 30; **39.** "fully out" July 25; **40.** "full bloom, probably some time," September 21.

49. CONVOLVULUS SEPIUM. **8.** "a solitary flower," June 11; "on 22 some buds were seen," which probably flowered by the end of the week. No buds elsewhere up to June 30; **9.** August 20, "in great numbers this year;" **12.** "fine and very plentiful;" **13.** "on a railway bank," June 12; **27.** very early.

50. *Symphytum officinale.* **10.** June 8, too late in date; very early at **8** and **28.**

51. *Pedicularis sylvatica.* **4.** "by" April 10; **8.** "several days," April 19; **9.** April 18, "few plants, very small;" **40.** "in bloom at Beeston Regis, May 7;" very early at **33.**

52. *Veronica Chamædrys.* **9.** April 25, "in great numbers;" **12.** "flowers of a remarkably full blue this year;" **24.** "probably late," April 29; **32.** "in flower" May 14; **41.** "abundant at Gresford," May 8; **42.** specimen rather advanced.

53. *Veronica hederifolia.* **4.** "flower and young fruit by February 11;" **11.** specimen seen February 26; **37.** "full seed" May 2.

54. *Mentha aquatica.* **4.** "by July 31, must have been in flower several days;" specimens from **2** and **28** advanced.

56. *Prunella vulgaris.* **3.** "several" June 7; **13.** "many out" June 20; **14.** specimen sent very advanced.

57. *Nepeta Glechoma.* **13.** "nearly open" March 28; **27.** "by a few days," April 11; **29.** "in flower" March 28; "in several places" March 29; **32.** "in flower" April 18; **40.** "full bloom, plenty," March 21, remarkably early.

58. *Galeopsis Tetrahit.* **4.** "by" June 26; **9.** "just out," July 15; **11.** specimen seen June 17; rather variable in its time of flowering.

59. *Stachys sylvatica.* **9.** "a few specimens" July 13.

60. *Ajuga reptans.* **4.** "by" April 24; "flower open 2 or 3 days;" specimen rather advanced; **14.** specimen sent very advanced; **19.** at Essenden April 16.

61. PRIMULA VERIS. **9.** "in a little valley," February 3; **19.** "2 weeks later on clay soils;" **25.** "commonly in flower, but very stunted," April 10; **36.** March 30, "not general before April 13; like other plants most erratic in time of flowering;" **37.** "said to have been in flower April 3."

62. *Plantago lanceolata.* **4.** "by April 3, flowers 2 or 3 days old."

63. *Mercurialis perennis.* **2.** "a few barren," March 20; very late; **4.** specimens rather advanced; **8.** barren, March 8; fertile, April 10; **11.** barren, February 26; fertile, March 7; **14.** specimen sent had no flowers open; **19.** "only a few here and there," March 8; **25.** April 22, very late; **34.** barren and fertile, March 8; **37.** Farley, March 30; Oakamoor, March 21; specimen 15 inches high, May 14; very slow in coming into flower; **40.** "in bloom several days," March 21; **41.** at Gresford, February 22.

64. *Ulmus montana.* **37.** "full flower," March 24.

65. *Salix caprea.* **1.** "well out" February 18; **4.** "by" March 13, "barren flowers abundant at Ashton and Halden; not found in Trusham;" **8.** fertile, March 12; barren, March 13; **9.** "full bloom in sheltered wood," March 19; **19.** "in plenty," March 9; **22.** "full bloom, near Waltham," March 10; **32.** "Salix (Palm willow)" in flower, March 21; **34.** "2 or 3 days," March 15; **36.** "last week in March;" **37.** "full flower" March 29.

66. *Corylus Avellana.* **2.** "barren," March 15; **4.** "by February 21; barren and fertile flowers in abundance in Teign Valley;" **6.** barren, February 18; fertile, February 25; **8.** fertile, February 13; barren, February 25; **11.** fertile, February 14; barren, February 21; **13.** barren, several, February 22; fertile, February 29; **16.** "male catkins remarkably late," February 20; fertile, February 22; **19.** barren and fertile, February 17; **26.** fertile, February 19; barren, March 8; **33.** "much found March 5;" **34.** barren and fertile, February 25; **37.** "catkins," March 30; *said* to have been seen March 15. Very late at **42**, and very early at **43**. Specimens from **4** and **12** much advanced.

67. *Orchis maculata.* **37.** "becoming general" June 24; **40.** "in bloom at Causton," June 18.

68. *Iris Pseud-acorus.* **2.** "in bud for a week," June 10; **8.** "first flower withered;" **12.** "coloured bud May 30; few flowers withered, June 18;" **28.** "by" June 29; **31.** "plentiful," June 7.

69. *Narcissus Pseudo-narcissus.* **4.** "by March 7; by Teign, 3 or 4 days;" **9.** "in great numbers" March 3; "flowers very small;" **17.** double variety sent; **19.** "full" March 16; **37.** "full bud" March 21; "cultivated," March 28; "in field only in mature bud, April 23;" very late; **40.** "full at Elsing in shrubbery," March 19.

70. *Galanthus nivalis.* **1.** February 4, "average date January 24;" **4.** "in Teign Valley;" **14.** specimen sent was a double flower, not wild; **27.** "by 1 day," February 18; **34.** cultivated, February 18; **37.** "by" February 26.

71. *Endymion nutans.* **1.** April 7, "about average date;" **9.** May 5-25, "abundant still, whole banks covered with it;" **12.** "flowers remarkably beautiful and fine;" **19.** "has been a long time opening its flowers on account of the cold NE winds;" **24.** "just coming out," May 1; **32.** "in flower," April 18; **41.** "plants in quantity, only 2 or 3 loose flowers open as a rule," May 7.

ENTOMOLOGICAL REPORT FOR 1880. By the Rev. CHARLES H. GRIFFITH, F.M.S.

I DO not wish to commence my report this year, as on the last occasion, with a jeremiad of complaints with regard to the paucity and meagreness of the observations sent to me. I would only remind the staff that it is entirely from the number of the observations in different localities and the diligence with which first appearances are searched for, that these reports can produce any really good result. It has, I believe, been proposed to revise and alter the lists of Insects to be observed; of course I bow to superior judgment, but, if I may be permitted to offer my own humble opinion on this point, I would certainly make very slight alteration: except that I think *Trichocera hiemalis*, the Winter Gnat, might be omitted, because this insect may be seen nearly every mild day from November to March, and therefore gives no further indication than that the weather was fine and mild when the insect was seen. I would also dismiss *Rhizotrogus solstitialis*, the Fern-chafer, because it is a very local insect, entirely unknown in very many districts. *Bibio Marci* (St. Mark's Fly) might also be dispensed with, as its appearance is only recorded at three stations out of 25, with an interval of observation from April 25th to June 26th, although the Fly is commonly distributed and so well marked with its black hairy body and legs that I should have thought it could hardly have escaped observation. My reason for suggesting so little alteration in the Insects to be observed is that the list emanated from the pen of a most trustworthy naturalist, and includes well-known and common species whose appearances and numbers fairly represent the condition of the weather from January to July. And also because if the list were altered and amended, all previous observations would be useless for purposes of comparison, and we should have to begin our calculations of results entirely *de novo*. It appears to me that what we really want is not an alteration of our present adopted species, but a little more alertness and watchfulness in carefully observing what we have already selected.

From the observers' notes and from my own observations I am compelled to remark that the late season has not been particularly good for entomological research. Insects of all kinds have been scarce, and more variable than usual in the times of their appearance. Great disparity of dates therefore appear in the returns of observers, the first appearance of *Apis mellifica*, the Honey Bee, for instance, ranging from January 2nd to April 7th, and *Pieris Brassicæ* from March 29th to June 11th. As is so frequently the case in "bad" years, rarities have been more numerous than usual, *Colias Edusa* (the Clouded Yellow Butterfly) has been reported from several districts; Marlborough reports its first appearance on August 26th. I have also seen several and captured a few. Marlborough also comes to the front again in recording the capture of a Camberwell Beauty, *Vanessa Antiopa*, on August 30th.

The entomological year has been chiefly marked by the wonderful number

of wasps, *Vespa vulgaris*, due chiefly to the fairly fine weather during their period of incubation in the grub state. The first Queen recorded was seen at Strathfield Turgiss on the 10th of March, and nests have been numerous to a wonderful extent in this and other neighbourhoods. As many as 71 nests have been destroyed on one small farm or estate near this station. These insects are great pests in the Autumn, especially during the fruit season, and they try the temper of the grocers here considerably. A plan has been tried here which answers well in effecting a diminution of their numbers, and that is, to offer to the small boys of the village, who are rather proud of being stung, a reward of 6d. for each Queen wasp brought dead before say the last day of March or the 14th of April: as these are the founders of the future colony, their execution lessens the coming broods. To any who thus benevolently endeavour to help their neighbours by the destruction of these pests, it is as well to suggest that it is expedient that the head or abdomen of the Queen-wasp, so paid for, be clipped from the animal on its presentation for payment, or else, in these degenerate days, he may be called upon to pay twice or even more frequently for the same creature. To destroy the nests, a good plan is to pour quickly about ½ an ounce of bi-sulphide of carbon into the aperture of the nest, if vertical; or to inject with a small glass syringe if the hole be oblique, and then stop the hole. In a very few seconds the wasps will all have perished. But those who use the bi-sulphide should be warned that it is a dangerous liquid to play with.

The report from Bath this year is unusually good and full, and draws attention to a point I have myself observed—viz. that the month of April was a remarkably unproductive month, very few insects of any kind having been seen. Attention is also drawn by this observer to the early appearance of *Macroglossa stellatarum*, the Humming-bird Moth, on the 18th of March. The charming little denizen of our woodland hedges, the *Anthocharis Cardamines*, Orange-tip Butterfly, has been very scarce, and I have not heard of one female having been observed. The observer at Great Cotes reports great injury done to the crops of oats and barley by the larvæ of a species of *Tipula* or Crane-fly. He says, "No top dressing of lime, soot, or salt appears to have any effect in destroying these obnoxious and extremely injurious grubs. The only plan I have found available in any way for checking their ravages is by repeated and heavy rolling of the land. It is," he adds, a "very good plan in the Autumn, before ploughing in the clover stubbles to dress the land with 'gas-lime,' thereby either destroying thousands of the eggs of the fly, or in some manner checking their development."

The observer at Geldeston, Norfolk, draws attention to the fact that she has noticed "holes cut out at the base of the corolla of the Snapdragon, *Antirrhinum majus*, sometimes the whole of the corollas being cut, during the month of July, and asks if there be some special insect that does this. There is I know a Leaf-cutter Bee, *Megachile*, but whether this Bee attacks the Snapdragon I am unable to say; but if the observer would kindly send me the aggressor in question, I probably could advise her.

At this station the Gooseberry and Currant trees have suffered severely from the attacks of the Gooseberry Saw-fly, *Nematus Ribesii*, but in all cases where the suggestion of Miss Ormerod of laying cloths saturated with gas tar around the stems on the ground under the trees has been adopted, the plague has been abated.

The observer at Farley entirely bears out my remarks upon the barrenness of the past entomological year, and adds that with careful observation he has only seen three white Butterflies, and his assistant only one. The brown Butterflies (*Epinephile Janira*) and the Cockchafers (*Melolontha vulgaris*) he says have also been exceedingly scarce.

Appended is a summary of the observers' notes of the year.

79. *Trichocera hiemalis*, the Winter Gnat, has been observed nearly every mild day.

74. *Apis mellifica*, the Honey Bee. Uppingham, January 2; Trusham, February 13; Cardington, February 16; Hatton, February 19; Hertford, February 23; Watford, March 1; Addington, March 4; Isleworth, March 6; Great Cotes, March 7; Strathfield Turgiss, March 9; Odsey, March 9; Bath, March 12; Cheltenham, March 21; Harpenden, April 7.

76. *Pieris Rapæ*, Small White Butterfly." Marlborough, March 5; Downside, March 11; Addington and Cardington, March 24; Strathfield Turgiss, March 24; Hertford, March 25; Ardbourne and Cheltenham, March 29; Trusham and Maker, March 30; Ware, April 17; Babbacombe, April 20; Isleworth and Great Cotes, April 30; Bishop Frome, May 1.

75. *Pieris Brassicæ*. Trusham, March 29; Watford, April 19; Uppingham, April 22; Harpenden, April 30; Strathfield Turgiss, May 1; Babbacombe, May 5; Totness, May 13; Downside, May 18; Great Cotes, May 30; Marlborough, June 11.

78. *Bibio Marci*, St. Mark's Fly. Watford, April 25; Strathfield Turgiss, May 1; Great Cotes, June 26.

72. *Melolontha vulgaris*, the Cockchafer. Downside, May 4; Uppingham, May 14; Strathfield Turgiss, May 17; Cheltenham, May 26; Totness, July 7.

77. *Epinephile Janira*, Meadow Brown Butterfly. Hertford, May 24; Uppingham, May 29; Strathfield Turgiss, June 13; Totness, June 30; Addington, June 21; Isleworth, June 24; Bradenham, June 28; Great Cotes, June 29; Hatton, June 30; Marlborough, July 8.

Gonopteryx Rhamni, Brimstone Butterfly. Strathfield Turgiss, February 10; Addington, March 7; Uppingham, March 18; Downside, May 1.

Anthocharis Cardamines, Orange Tip Butterfly. Strathfield Turgiss, April 30; Bradenham, May 1; Bath, May 13; Marlborough, May 14; Addington, May 17; Babbacombe, May 21; Hatton, June 19.

Vanessa urticæ, Small Tortoise-shell Butterfly. Downside, February 1; Strathfield Turgiss, February 18; Hatton, March 5; Marlborough, March 9; Addington, March 15; Bradenham, March 17; Uppingham, March 25; Cheltenham, March 28.

Vanessa Io, Peacock Butterfly. Strathfield Turgiss, March 11; Marlborough, May 15; Downside, May 25; Uppingham, March 28.

Pyrameis Cardui, Painted Lady Butterfly. Strathfield Turgiss, May 26; Downside, May 27; Marlborough, May 30; Addington, June 28.

REPORT ON THE ORNITHOLOGICAL OBSERVATIONS. By JOHN CORDEAUX.

OBSERVATIONS have been received from 82 stations in England, against 25 in 1879 and 21 in 1878.

Stations forwarding reports are:—**2.** Babbacombe; **3.** Totnes; **4.** Trusham; **8.** Salisbury; **9.** Downside, Bath; **10.** Strathfield Turgiss; **11.** Marlborough; **12.** Isleworth; **13.** Watford; **14.** St. Alban's, Redburn Bury; **15.** St. Alban's; **16.** Harpenden; **17.** Ware; **19.** Hertford; **20.** Hailey Hall, Hertford; **21.** Throcking; **22.** Hoddesdon; **24.** Kimpton; **25.** Addington; **26.** Bradenham; **28.** Bocking; **29.** Odsey; **30.** Cardington; **32.** Cheltenham; **33.** Bishop Frome; **34.** Uppingham; **35.** Hatton; **36.** Great Cotes; **37.** Farley; **40.** Sparham; **41.** Chester, and **42.** Parbold.

The Hertfordshire stations are comparatively within such a circumscribed area that it is not considered necessary to treat them separately, but only as a group. These Stations are, St. Alban's (Redburn Bury), St. Alban's, Harpenden, Ware, Hertford, Hailey Hall, Throcking, Hoddesdon and Kimpton; they are represented in the report by the Hertford number, **19.** In every case the earliest dates in this district, as reported from any station within the area, has been taken as indicating the earliest arrival, song, nesting, &c.

Only one station of the 82 sending notes, Parbold, is north of the Humber. The notes extend from the commencement of the year to the end of October.

As in the last report, the notes are divided under the headings *song*, *migration*, *nesting*, *other notes* and *general remarks*.

SONG.

88. SKYLARK (*Alauda arvensis*). First heard: **8.** January 8; **9.** January 5; **10.** January 10; **12.** February 8; **19.** January 3 and 4; **28.** January 27; **29.** January 8; **30.** February 4; **34.** January 31; **35.** February 1; **36.** January 31; **40.** January 7; **41.** February 1; **42.** February 11.

First at Salisbury, Odsey, Hertford, Downside and Sparham, in Norfolk; latest at Isleworth, in the Thames Valley, and Parbold, Lancashire. With the exception of Isleworth, is earliest in the southern stations, latest in the more northern.

The average date of the Lark's first song, as observed at 10 stations, in 1878 was January 27; in 1879, at 11 stations, February 10; and in 1880, at 14 stations, January 20th—that is, a week earlier than in 1878, and three weeks earlier than in 1879.

82. THRUSH (*Turdus musicus*). Song first heard: **9.** February 10; **19.** January 17; **25.** January 5; **28.** February 18; **29.** February 3; **30.** January 1; **34.** January 29; **35.** February 20; **36.** February 2; **37.** February 7; **40.** February 8; **41.** January 9.

Earliest at Cardington, Addington and Chester, latest at Hatton and Bocking; was also earliest at Cardington and Chester in 1879.

Taking the average of 18 stations in 1879 against 12 in 1880, the song commenced earlier in the last year by six days. The average date of the song in 1879 was February 4, in 1880, January 29.

Blackbird *(Turdus Merula)*. Song first heard: **9.** February 10; **19.** February 7; **34.** February 22; **35.** March 6; **36.** February 8. Earliest Great Cotes, North Lincolnshire.

91. Cuckoo *(Cuculus canorus)*. First heard: **2.** April 30; **4.** April 28; **8.** April 15; **9.** April 21; **10.** April 15; **11.** April 20; **12.** April 18; **13.** April 12; **19.** April 16; **25.** April 17; **26.** April 20; **28.** April 16; **29.** April 23; **30.** April 23; **32.** April 23; **33.** April 19; **34.** April 21; **35.** April 25; **36.** April 28; **37.** April 16; **40.** April 22; **41.** April 27; **42.** April 22.

The Cuckoo, like the Swallow, is tolerably certain to attract general attention; it is reported from 23 stations, all of which fix the date of its first call between April 12 and April 30. Again, for the third time, the most westerly and northerly stations are the latest, showing, as has been remarked upon in previous reports, that the line of migration of the Cuckoo is from SE to NW, probably crossing the Channel at the narrowest point between Calais and Dover, and gradually extending its range northward and westward. The latest stations are this year Great Cotes, April 28, and Babbacombe, April 30.

Several stations report the Cuckoo as seen some days previously to hearing its notes; this is not unlikely to be the case, as observation has shown that other species besides the Cuckoo, in cold and inclement weather, are silent for some days after their arrival.

An average of 23 stations in 1879, against the same number this year, show that the Cuckoo's note was heard in 1880 about two days earlier than in 1879, and three days earlier than in 1878.

84. Nightingale *(Daulias luscinia)*. Song was first heard: **9.** April 29; **10.** April 18; **12.** April 19; **13.** April 9; **19.** April 16 (the 9 Hertford Stations only vary four days); **25.** April 27; **26.** May 2; **28.** April 23; **29.** April 19; **34.** April 17; **36.** April 27; **40.** April 20. Earliest at Watford, April 9; latest at Bradenham, a neighbouring station, May 2. As this station is the nearest to Watford it is reasonable to suppose that the Nightingale was in the neighbourhood much earlier, more particularly as it was heard at places far north of Bradenham from the middle to the end of April. At Great Cotes, making the most northerly report, on April 27.

A comparison of the returns from 14 stations in 1879, against 12 in 1880. shows that the song of the Nightingale was heard from 4 to 5 days earlier in this year than in 1879.

86. Willow Wren (*Phylloscopus trochilus*). Song first heard at **26.** April 9; **32.** April 22; **34.** April 4; **35.** April 17; **36.** April 17; **40.** April 15. Earliest at Uppingham, latest at Cheltenham; about four days earlier than in 1879.

87. Chiff-Chaff (*Phylloscopus collybita*). Note first heard; 19. March 16; 25. March 15; 26. March 17; 30. March 17; 34. April 4; 35. March 30; 40. March 14. Average time of arrival about the end of the third week in March; earliest at Sparham, March 14; latest Uppingham, April 4.

94. Turtle Dove (*Columba Turtur*). First heard at 10. May 6; 26. May 14; 29. May 12; 30. May 21; 36. May 27; 40. May 25. Earliest, Strathfield Turgiss, May 6; latest near Great Cotes, May 27.

89. Chaffinch (*Fringilla cælebs*). Song first heard at 19. January 31; 26. January 2; 30. February 18; 34. February 1; 35. February 8; 36. First week in February; 40. February 20; from January 2 at Bradenham, to February 20 at Sparham, Norfolk.

Migration.

92. Chimney Swallow (*Hirundo rustica*). Was first seen at 2. May 17; 8. April 26; 9. April 22; 10. April 20; 11. April 11; 12 April 18; Maldon, Essex, April 19; 13. April 12; 19. April 8, 15, 16, 17, Hertford and neighbourhood; 25. April 17; 26. April 16; 29. April 20; 30. April 22; 33. April 18; 34. April 23; 35. April 20; 36. April 17; 37. April 22; 40. April 21; 41. April 4; 42. April 22.

Earliest at Chester, April 4, which was also the earliest station in 1878. Latest at Babbacombe, May 17. It is certainly remarkable that this, the most southern of our stations, has now made the latest return for three years in succession. Excepting Babbacombe we have 23 stations reporting the first arrival of *H. rustica*, from April 4 to April 26. In 1878, Chester, Great Cotes, and Bishop Frome returned the earliest arrivals, and in 1879 certain stations in North Wales were amongst the first to report the Swallow. The average of the 24 stations this year is April 19, later by a day than the average of 23 stations in 1879.

93. Swift (*Cypselus apus*). First seen at 3. May 10; 9. May 13; 10. May 16; 11. May 11; 12. May 18; 19 May 8; 25. May 19; 26. May 15; 29. May 13; 32. May 18; 34. May 14; 35. May 22; 36. May 28; 40. May 22. Observed at 14 stations, from Hertford, May 8, to Great Cotes, May 28. Earliest in the southern, latest in the more northern stations. Marlborough was one of the earliest stations both in 1879 and 1880, also in 1878.

Average date of arrival May 16; in 1879 it was five days earlier, namely, May 11.

81. Fly-catcher (*Muscicapa grisola*). First seen at 26. May 19; 29. May 30; 34. May 10; 35. May 26; 36. May 29; 40. May 28. Earliest at Uppingham, May 10; latest at Sparham, May 28, and Great Cotes, May 29. In 1880, the average arrival was May 24; in 1879, May 19.

85. Wheatear (*Saxicola Œnanthe*). First seen at 11. Marlborough, March 28; 36. Great Cotes, April 6.

88. Fieldfare (*Turdus pilaris*). Last seen in the spring of 1879; 40. April 12, Sparham; "April 8 seen flying high towards north;" and again on April 16 "in the evening 12 flying high towards the north."

96. Woodcock (*Scolopax rusticola*). The first flight arrived on the night of the 18th, or early morning of 19th October, on the east coast from Flamborough to Yarmouth, wind NNE. Many were shot both on the Yorkshire and Lincolnshire coast on morning of 19th.

Nesting.

82. Thrush (*Turdus merula*). **9.** April "4 eggs sitting;" **10.** April 6 "nest and eggs;" **11.** April 9 "4 eggs;" **12.** March 14 "2 eggs;" **25.** March 9 "nest and eggs;" **29.** March 21 "sitting, 4 eggs;" **34.** March 28 "sitting, 4 eggs;" **35.** April 10 "several nests with eggs;" **37.** March 27 "nest with eggs;" **40.** April 7 "nest with 4 fresh eggs."

Earliest nesting March 9 at Addington; latest at Downside, April 13; quite as early in the north as in the south. Not sufficient data to draw any comparison between 1879 and 1880.

90. Rook (*Corvus frugilegus*). **9.** March 26 "sitting;" **11.** March 18 "4 eggs;" **12.** March 30 "building;" **19.** March 5 "building;" **25.** March 6 "building;" **29.** March 4 "building;" **30.** March 13 "building;" **34.** March 7 "building;" **35.** March 15 "10 nests completed;" **37.** March 18 "building;" **40.** March 6 "building for several days past;" **41.** March 3 "building;" **36.** March 6 "building."

Generally building at all stations early in March; on the average are quite a week later than in 1879 in commencing to build, and a fortnight later than in 1878.

Other Notes.

Swallow Tribe. The observer at Salisbury, under date September 1880, remarks: "A few Swallows (species could not be distinguished) were seen above the Close on September 28, the last hitherto observed. On 14 a perfect cloud of Swallows and House Martins were flying at about half the height of the elms in the Close. Since that day House Martins, as far as observed, have been the minority instead of the great majority of their tribe in the Close. On 21 none were seen till just after sunset, when a large flight crossed the garden of the house from N to S, wheeling as they flew, but steadily moving southward and disappearing in that direction. A similar but smaller flight on 22. On 24, about 3 miles up the valley, a large flight was seen just above the escarpment of the chalk and alighting frequently on the Downs. The sun was shining brightly and their white stomachs flashed as they wheeled, but I failed to discover the white tail coverts of the House Martin."

And then a subsequent note, October 1:—"Swallows still here, a better eye than mine was able to distinguish Swift House Martins and Chimney Swallows. Same observer agrees that the bulk of the House Martins disappeared immediately after September 14, a pair had then a newly-finished nest and these remained."*

* In the 'Zoologist,' for 1881, p. 62, the Editor has given a list of 8 stations, with the exception of Dublin, all in the South of England, at which the Swallow was seen in November and December, ranging from Lymington, Hants, November 22, to Walmer, December 11. A Martin was seen at Henley-on-Thames on December 18.

General Remarks.

The Spring of 1879 will long be remembered as one of the coldest and most backward of the present century; the temperature was abnormally low, sharp frosts and snow to the end of the first week in May, and then a succession of heavy downpours of cold driving rain. The Spring of the present year was a remarkable contrast, generally fine and dry, with the temperature quite equal, if not above, the average of the season. Two such opposite Springs, occurring in consecutive years, offer unusual facilities for noting the effects of the weather on the song, migration, and nesting of birds.

First, then, with regard to the song: on comparing the data collected in the two seasons of 1879 and 1880, we shall see that birds (such as are termed residents) commenced singing earlier in the latter year by some days. Thus, taking the average of the stations, Skylarks began their song *three* weeks earlier in 1880 than in 1879. The Song-Thrush was *six* days earlier. The Cuckoo, one of the most familiar of our summer immigrants, coming to us in April, be the weather fair or foul, does not show any very striking difference in the time of its arrival in our hedgegroves and copses. The familiar call-note was heard two days earlier in 1880 than in 1879, and three days earlier than in 1878. When we also take into account the fact that it is often *seen* some days in advance of its call-note being heard, it does not appear that cold and backward seasons have much effect in retarding its appearance. In the case of the Nightingale, however, the song was heard four or five days earlier than in 1879; and the *Willow Wren* four days earlier than in 1879.

On the regular migratory movement of birds the character of the season appears to have very little effect. A comparison of 24 Stations in 1880 against 23 in 1879 shows that *Swallows* were a day later this year in arriving at their summer haunts.

It is a curious fact that Babbacombe, near Torquay, in Devon, has now, for three consecutive seasons, sent in the latest returns for the first appearance of the Swallow. It is also noteworthy that the more northern stations are frequently the earliest. To these swift-winged wanderers a dash from sunny France northward to their summer quarters near the Dee or Humber is only a matter of a few hours. A fine warm day tempts them northward, and we see a pair in some familiar haunt where we have been in the habit for years of looking for the first Swallow. Cold weather supervenes, or they do not find things quite as they expected, no insects on the wing, and they are gone —days may elapse before they are again noted, then perhaps a pair or two are seen, this time to remain, and soon with the first burst of really fine weather they come, "not single spies, but in battalions."

With our smaller birds and summer warblers the spring migration is gradual, a flitting from one hedge to another, from one woodland to the next, till they finally arrive at their summer haunts.

The *Swift* seems even less under the influence of the weather than the

Swallow, if we may judge by the various reports sent in, for it was, on the average, 5 days later in 1880 than in 1879.

With regard to the early or late nesting of birds, as influenced by weather, the data are not sufficient to give any very reliable opinion. The *Rook*, contrary to what might have been expected, commenced building a week later than in 1879, and a fortnight later than in 1878.

DISCUSSION.

Mr. SCOTT said that the review of the features of the weather contained in the paper was, in his opinion, too general, and referred chiefly to central England for the character of the season; for instance, in Ireland it had been very dry throughout the harvest time, while a recent letter to the 'Times' had described the harvest weather of 1880 as even worse, owing to wet, than that of 1879.

Mr. BALDWIN LATHAM said that he wished to draw the attention of the Fellows to the immense value of these Phenological Reports to the agriculturist. By reference to the report of last year it would be seen that the enormous number of slugs which attacked every green thing had been duly reported. If this incident had been noted by the agriculturists of the country, and steps had been taken to counteract the evil effects likely to follow such an abundant appearance of slugs, many thousands of pounds would have been saved to the agricultural community, and the disease known as "sheep-rot" might have been, to a considerable extent, prevented by suitable dressings of the pastures, which would have destroyed the slugs which harboured the germ of the *entozoa* and caused the disease. The sheep-rot, as was well known, was an entozoic malady, but was not transmitted from sheep to sheep, for in the life of most *entozoa* the first stage of existence was developed in creations of the lower order of life, especially in slugs, which were so abundant at the period preceding the outbreak of sheep-rot. The destruction of these slugs, therefore, would have destroyed the "host," and have prevented the sheep-rot, and the consequent loss which had arisen by the prevalence of the disease. There was no such appearance of an unusual development of slugs in Surrey at present, and therefore in this district the likelihood of an epidemic of sheep-rot in the ensuing spring was not probable. If, however, in any district of England slugs are unusually prevalent, it was desirable that the agriculturist should take steps to destroy them before the period arrived when they would create mischief. From numerous inquiries which he had made throughout the country with reference to the crops in the past year, he could state that there were some districts in which the crops had been under the average; in some districts they had been above the average, but, on the whole, the past year had not been a bad one for the agriculturist, especially when compared with the previous year 1879. The grass of the present year, he had been assured by many agriculturists in various parts of the country, was of a far better quality, and was much easier to fatten cattle upon, than it was with the addition of cake in 1879. With regard to the earlier appearance of many plants at the commencement of the present year, it should be observed that the temperature of the ground was unusually warm, but from April 10th to 12th there was a considerable check, and the temperature of the ground fell even at a depth of 3 feet, which may account for the late appearance of certain plants in that month; indeed about that time the wall fruit out in bloom in many places was destroyed by frost. He concluded by returning his thanks to the authors, for such reports were of great value, especially to the agriculturist.

Mr. EATON remarked that, judging from its effect on vegetation, the frost of December and January of last winter had been not only absolutely but relatively much more severe in parts of Germany and France than in Great Britain. He had noticed last July, in the valley of the Rhine between Strasburg and Basle, that the majority of the walnut and cherry trees, many of them of stately growth and predominant trees of the district, had been killed by the frost referred to. Their leafless boughs gave a strange and weird appearance to the summer landscape. The branchlets of such trees as survived were mostly destroyed, and the trees had sent out abnormal clusters of new shoots from their larger branches and

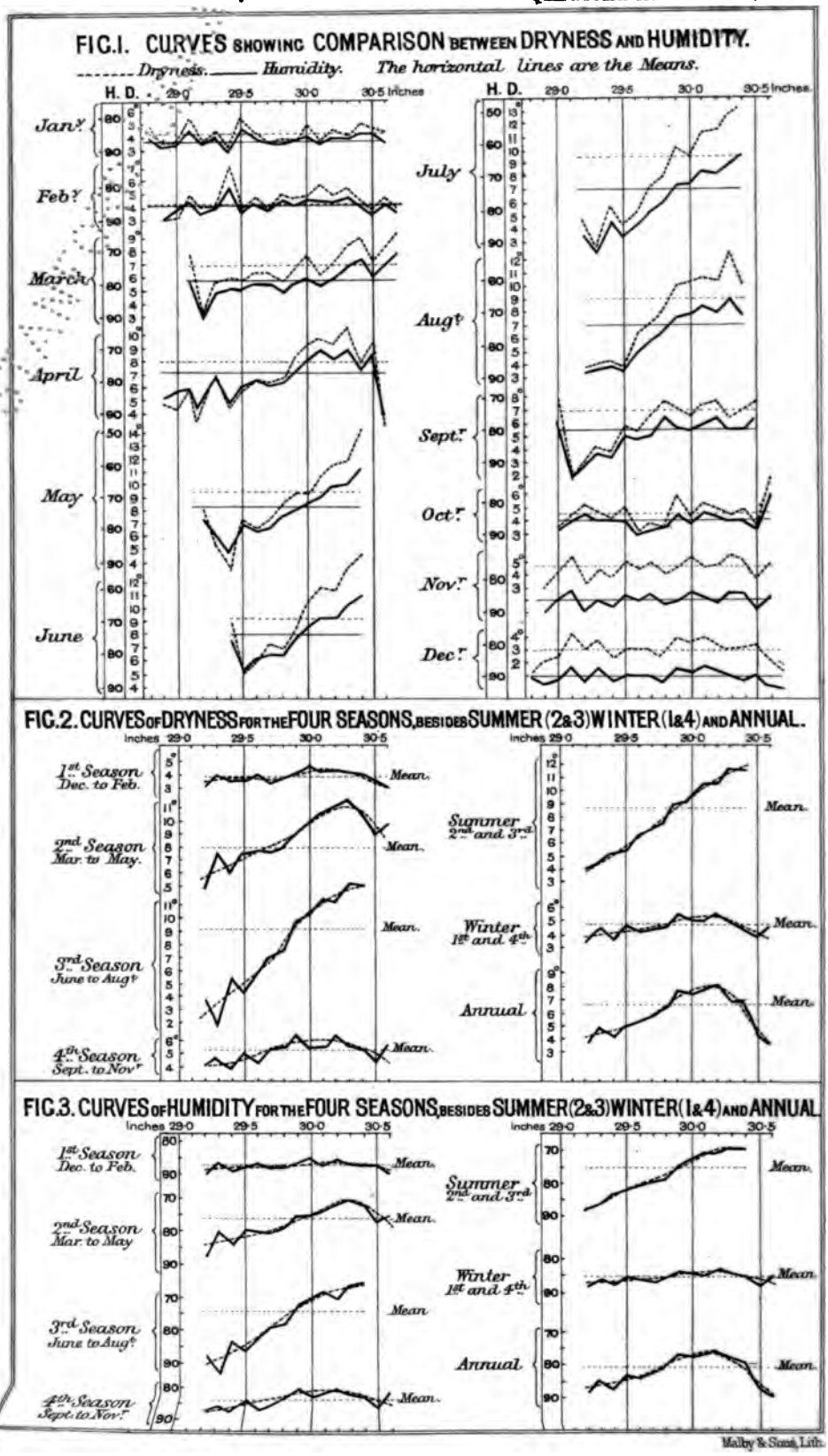


FIG. 1. CURVES SHOWING COMPARISON BETWEEN DRYNESS AND HUMIDITY.
Dryness. Humidity. The horizontal lines are the Means.
H. D.
29·0
29·5
30·0
30·5 Inches
Jan.y
Feb.y
March
April
May
June
July
Augt
Sept.r
Oct.r
Nov.r
Dec.r
FIG. 2. CURVES OF DRYNESS FOR THE FOUR SEASONS, BESIDES SUMMER (2&3) WINTER (1&4) AND ANNUAL.
Inches
1st Season Dec. to Feb.
2nd Season Mar. to May.
3rd Season June to Augt
4th Season Sept. to Novr
Mean.
Summer 2nd and 3rd
Winter 1st and 4th
Annual
FIG. 3. CURVES OF HUMIDITY FOR THE FOUR SEASONS, BESIDES SUMMER (2&3) WINTER (1&4) AND ANNUAL.
Malby & Sons, Lith.

stems. On higher ground in Switzerland these trees had entirely escaped injury. The Rev. A. E. Eaton, whose attention he had directed to the circumstance, subsequently observed the same effects on the walnuts in France nearly as far south as Toulouse.

THE PRESIDENT (Mr. Symons) was glad that the assistance of the Editor of the 'Natural History Journal' and that of the Hertfordshire Natural History Society had been procured; and thought that there ought to be more co-operation given by the Natural History Societies throughout England than there is at present. With respect to the local intensity of the frost on the Continent, he could corroborate Mr. Eaton's remarks, as he heard that the locks on the canals between Strasburg and Metz had been greatly damaged by the ice. He hoped that some one would investigate the geographical distribution of the frost of December and January last.

Mr. SCOTT said that when in Switzerland in the autumn he had learnt that, owing to the deficiency of snow last winter in the Bernese Oberland, no ascents of some of the peaks had been feasible from the northern side.

Rev. T. A. PRESTON said that observations of the temperature of the soil were very desirable, and would no doubt account for some of the early appearances of the plants, as shown in the diagram. He was trying to make a table of the depth to which the roots of the several plants extend. With regard to the destroying of the vine, he had no doubt that the absence of snow would have a great deal to do with it, as he would have lost a great number of his plants had he not covered them up.

On the Variations of Relative Humidity and Thermometric Dryness of the Air with Changes of Barometric Pressure, at the Kew Observatory.

By G. M. WHIPPLE, B.Sc., F.R.A.S., F.M.S., Superintendent of the Kew Observatory. (Plate III.)

[Read December 15th, 1880.]

THIS Paper I would wish, by the kind permission of the Kew Committee, to lay before the Society as a continuation of, or supplementary to, the one I read on May 21st, 1879, "On the Relation between the Height of the Barometer, the Duration of Sunshine, and the Amount of Cloud, as observed at Kew Observatory." (Vol. V. p. 218).

In it, I showed that the amount of sky covered varies inversely as the barometric pressure, between the limits of 29·0 ins. and 30·3 ins., the variation being most rapid between 29·8 ins. and 30·1 ins. Also that above 30·3 ins. cloud increases with increasing pressure, attaining the mean at about 30·5 ins., and rising above it at 30·6 ins. I also then alluded to a comparison of these results with the legend on weather-glass dials, and indicated the points in which the two things agreed and disagreed.

In the discussion which followed the reading of the Paper it was suggested that it seemed more probable that the terms of the inscription had reference to the dryness or wetness of the air, rather than to the condition of the sky; and taking the words "Much Rain" at 28·5 ins., "Rain" at 29·0 ins., and "Very Dry" at 31 ins., such would appear to be the fact.

Without going further into this matter, it appeared desirable to find out the laws of the variations in Relative Humidity with the height of the barometer, and in accordance with the suggestion thrown out by our former President

(Mr. Greaves) I have at the same time embodied in the discussion the variation in dryness as well, accepting his definition of "thermometric dryness," as the difference between the dew-point and the temperature of the air.

It became evident at an early stage of the investigation, that as accidental fluctuations very largely tended to mask any law of variation that might exist, a considerable number of observations would have to be discussed in order to bring it out. Accordingly, I decided at once on dealing with 10 years' observations, and selected for the purpose the decade January 1870 to December 1879, using the MSS. records of the Kew Observatory. For simplicity and convenience I considered only the daily means derived from the eye observations made five times daily.

Having extracted the barometric reading to the nearest tenth of an inch only, and the Relative Humidity, the Thermometric Dryness was computed for the day.

The two latter values were then distributed into columns according to the height of the barometer for the day, and the mean monthly values found.

In the succeeding stage these were grouped under the different months of the year, and then the means of each column were again calculated.

The numerical results so obtained are given in Table I., and the values are shown graphically in Fig. I. (Plate III.) It will be seen at once that the two qualities, "Relative Humidity" and "Dryness," vary in precisely inverse ratio, as might be expected, both being derived from the same pair of

TABLE I.—Relative Humidity and Thermometric Dryness in different Months of the Year corresponding to different heights of the Barometer, derived from Observations made at the Kew Observatory, 1870-1879.

Pressure.	Jan.		Feb.		March.		April.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.	
	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.
Ins.	o/o	°	o/o	°	o/o	°	o/o	°	o/o	°	o/o	°	o/o	°	o/o	°	o/o	°	o/o	°	o/o	°	o/o	°
29·2	88	3·6	87	4·1	90	3·1	89	3·4	75	8·4	..	..	87	4·4	88	3·8	..	..	84	5·2	90	3·3	91	2·8
·3	86	4·4	86	4·3	82	5·8	79	7·0	83	5·3	..	..	93	2·1	..	..	87	4·2	85	4·8	86	4·3	88	3·7
·4	90	3·0	80	6·8	81	6·1	86	4·6	88	3·6	73	9·4	83	5·8	86	4·3	88	3·8	85	4·2	88	3·6	91	2·6
·5	83	5·5	88	3·8	81	6·2	82	5·9	78	7·4	84	5·3	87	4·2	87	4·1	82	5·8	85	5·0	85	4·8	90	2·9
·6	86	4·3	85	4·8	80	6·4	80	6·6	80	6·7	82	5·8	84	5·3	82	6·5	83	5·5	90	3·3	86	4·4	90	3·1
·7	88	3·6	86	4·0	80	6·4	80	6·4	79	7·2	80	7·3	80	7·1	79	7·3	82	6·4	88	4·0	85	4·8	90	2·9
·8	88	3·8	84	5·0	82	5·9	80	6·6	75	8·5	80	7·1	77	8·0	76	8·1	76	7·8	87	3·8	87	4·1	91	2·8
29·9	87	3·9	85	4·7	79	6·9	76	8·3	73	9·2	75	8·6	72	10·2	72	10·1	78	7·3	83	5·9	86	4·4	88	3·7
30·0	85	4·8	84	4·9	78	7·8	73	9·4	72	9·3	71	10·3	72	9·8	71	10·4	80	6·7	86	4·3	84	5·1	89	3·6
·1	88	3·7	84	5·4	80	6·3	71	9·8	70	10·8	69	11·6	68	11·3	69	10·7	78	7·5	83	5·2	85	4·4	88	3·8
·2	86	4·3	84	5·1	78	7·2	73	9·5	67	11·5	69	11·5	69	11·5	70	10·6	76	7·9	84	5·1	87	4·5	89	3·5
·3	86	4·2	83	5·3	75	8·4	70	10·7	66	11·8	65	13·0	66	12·5	66	12·6	80	6·5	85	4·5	84	5·3	90	3·0
·4	85	4·8	85	4·6	73	9.1	76	8·1	62	14·1	62	13·8	64	13·2	71	10·1	80	6·9	85	5·0	84	5·2	91	3·0
·5	85	4·8	88	3·7	78	7·3	72	9·5	..	..	..	..	..	..	..	..	76	7·7	89	3·5	89	3·5	90	2·9
30·6	87	4·4	85	4·6	..	..	91	2·9	..	..	..	..	..	..	..	..	..	..	78	7·0	85	4·5	94	1·9

observations, viz. the temperature of air and of evaporation. It is also clear that there is a very material difference between the curves for the different months, those for January, February, November, and December varying but to a slight extent from the normal values for those months, whilst in the months of June, July, and August the fluctuations reach a maximum.

As these results pointed so distinctly to a seasonal variation, another Table (Table II.) was prepared by massing together all the observations in the winter season, December, January, and February; for the spring season, March, April, and May; for the summer, June, July, and August; and for the autumn, September, October, and November.

TABLE II.—Relative Humidity and Thermometric Dryness in different Seasons corresponding to different heights of the Barometer.

Pressure.	Dec. Jan. and Feb.		March, April and May.		June, July and August.		Sept. Oct. and Nov.		Mar. to August.		Sept. to Feb.		Annual.	
	1st Season.		2nd Season.		3rd Season.		4th Season.		Summer 2 and 3.		Winter 1 and 4.			
	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.	Relative Humidity.	Thermometric Dryness.
Ins.	o/o	°	o/o	°	o/o	°	o/o	°	o/o	°	o/o	°	o/o	°
29·2	90	3·2	89	3·8	87	4·1	87	4·2	88	3·9	88	3·7	88	3·9
·3	87	4·0	80	6·4	93	2·1	86	4·5	86	4·3	86	4·3	85	4·9
·4	88	3·8	84	5·0	84	5·4	87	3·9	84	5·1	88	3·8	86	4·3
·5	88	3·8	81	6·4	86	4·5	84	5·0	83	5·4	86	4·4	84	5·0
·6	87	4·0	80	6·6	83	5·9	86	4·5	81	6·3	87	4·2	84	5·3
·7	88	3·5	80	6·6	79	7·2	85	5·1	80	6·9	86	4·3	83	5·6
·8	88	3·8	79	7·0	78	7·7	83	5·4	78	7·4	86	4·6	81	6·2
29·9	87	4·1	76	8·1	73	9·8	81	6·2	74	8·9	84	5·2	78	7·7
30·0	86	4·5	74	8·8	71	10·2	83	5·4	73	9·5	84	5·0	78	7·6
·1	87	4·2	73	9·5	69	11·3	83	5·5	71	10·4	85	4·9	77	8·0
·2	86	4·4	71	9·9	69	11·2	81	6·2	70	10·6	84	5·3	77	8·1
·3	87	4·2	70	10·3	66	12·6	83	5·6	68	11·5	85	4·9	78	7·5
·4	87	4·0	72	9·8	65	12·7	83	5·3	68	11·3	85	4·7	80	6·8
·5	88	3·7	77	7·8	..	..	87	4·3	..	..	87	4·0	86	4·6
30·6	90	3·1	75	8·7	..	..	81	5·7	..	..	86	4·2	89	3·6

The curves obtained in this manner are plotted down in Figs. II. and III. (Plate III.), and show for the first season very little increase in dryness or diminution in Humidity for an increase in barometric height.

In the 4th period a curve becomes evident, dryness rising from a minimum at about 29·4 ins., to a maximum about 29·9 ins. and 30·2 ins., from which it again falls to a low point at 30·5 ins.

In the 2nd or spring quarter we have a well-marked rise, progressing from a very low degree of dryness (3°·8), at a pressure of 29·2 ins., up to the high point of 10°·3, at the reading of 30·3 ins., falling away subsequently to 7°·8 at 30·5 ins.

In the 3rd or summer term the rise may be considered as virtually continuous between a minimum of 2°·1, with a low barometer of 29·8 ins., to a maximum of 12°·7, at the other extreme of 30·4 ins., the average being 9°·8, at pressure of 29·87 ins.

If we then merely divide the year into two halves, combining the 1st and 4th periods, as representing the winter half of the year, and the 2nd and 3rd as the summer half, we find as the result, that during the winter the variations in Dryness or Relative Humidity are but slightly affected by barometric height, the extremes of greatest moisture being at both ends of the barometric range, whilst the driest time occurs when the mercurial column stands at about 30·2 ins.

In the summer half year, on the contrary, we have the curve closely approximating to a straight line in form, indicating thereby that at this time of the year the atmospheric pressure varies in exact proportion to the dryness of the air, the greatest humidity occurring with the lowest barometer, and the greatest dryness with the extreme height.

Finally, taking the whole of the observations for the ten years, and massing them together, a curve is produced, which indicates that the period of greatest dryness is synchronous with that of a barometric reading of 30·2 ins., whilst the extremes of humidity occur with the barometer at either end of the space through which its column varies.

This curve resembles in a striking degree the one I deduced from the discussion of the relation between barometric height, sunshine and cloud—so much so, that I think it may be fairly adduced as evidence tending to prove that at Kew the amount of cloud and dryness of the air are in inverse ratio to one another, and, therefore, of course, as a rule, the clouds vary with the humidity; hence it follows that clouds observed at Kew are not brought from a great distance by the wind, but are probably formed comparatively near the place where they are seen.

Referring once more to the weather-glass legend, it may now be decided that this only holds good for the summer when the dryness varies directly with the height of the barometer. At other seasons forecasts founded on the basis of these terms will probably prove fallacious.

On the Relative Frequency of given Heights of the Barometer Readings at the Kew Observatory, during the Ten Years, 1870 to 1879.

By G. M. Whipple, B.Sc., F.R.A.S., F.M.S., Superintendent of the Kew Observatory. (Plate IV.)

[Read December 15th, 1880.]

In the preparation of the preceding Paper on "The Variations Relative Humidity and Thermometric Dryness of the Air with changes of Barometric Pressure," I found that the range of the barometer varied considerably in different seasons, and that also the relative frequency of the

FIG. 1.

RELATIVE FREQUENCY OF BAROMETRIC READINGS

Derived from ten years' Daily Means and five years' Hourly Observations at the Kew Observatory.

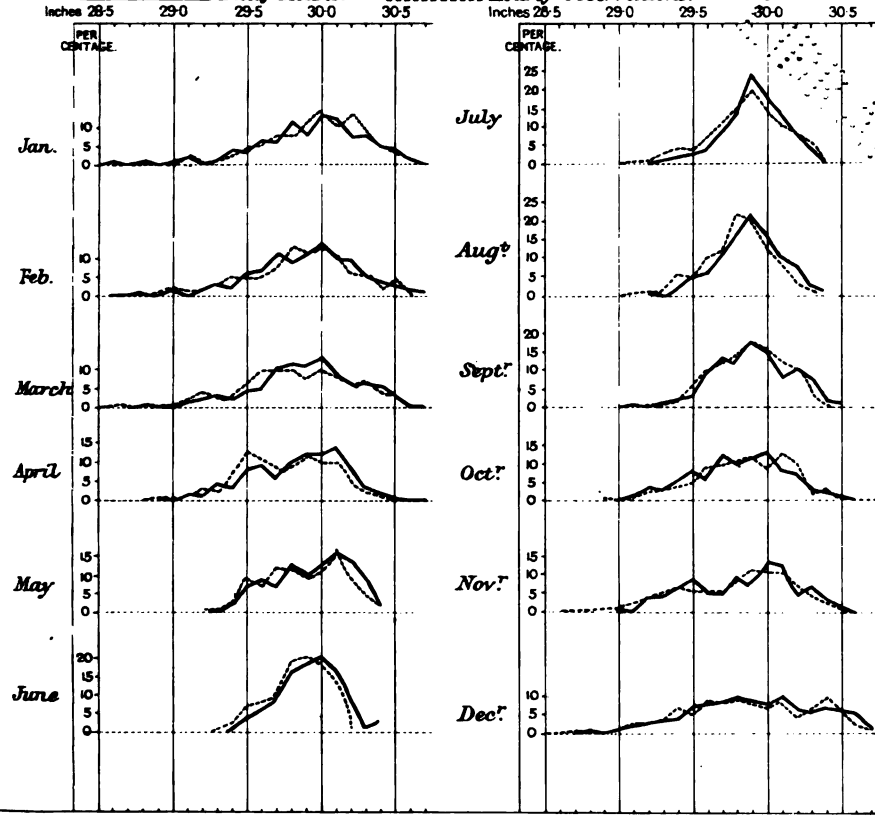
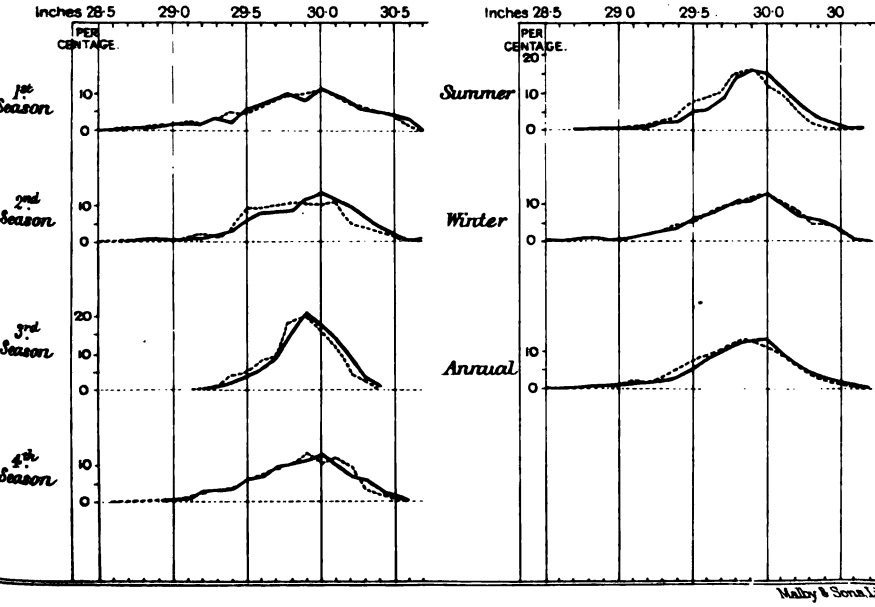


FIG. 2.



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readings at given heights varied from time to time. Therefore, by grouping together all the observations at the same height for every month, we are able to determine this relative frequency.

As in the Paper already referred to I had discussed the daily means of the observations at Kew Observatory for the ten years 1870-79, I first used these as the materials for the present Paper, and determined from them:—

A. The relative frequency of different barometric heights for each month.

B. The same for each of the four seasons, adopting the following as the best typical arrangement, viz. 1st season, December, January, and February; 2nd, March, April, and May; 3rd, June, July, and August; and 4th, September, October, and November.

Next, the 2nd and 3rd seasons were combined, to give the summer variations, and then the 1st and 4th the winter changes. Finally, taking the whole, the general law of frequency was obtained. These results are presented in the form of percentages in Table I., and the curves formed by plotting them down in Fig. I. (Plate IV.)

On inspection it will be seen that the barometer range is much greater in the winter months than in the summer, and that also there is a less preponderance of readings at any one pressure.

The extent of range covered by the daily means has varied during the ten years from 2·1 ins., viz. from 28·5 ins. to 30·6 ins. in January, to 1·0 in. (29·4 ins. to 30·4 ins.) in June.

Readings at very high or very low points are, however, extremely rare. There have been in the whole period but one day's mean each at 28·5 ins. and 28·6 ins., and 9 at 30·7 ins.

As might have been expected, the greatest frequency is at 30·0 ins., at which point 13·7 per cent. of the readings take place. Exceptions to this occur, however, in the months of July, August, and September, when the readings at 29·9 ins. are the more numerous, and also in April and May, when the percentage stands highest for 30·1 ins.

For any given month the actual maximum percentage of readings at one point is 23·9 in July, at 29·9 ins.; in the other months the highest numbers are as follows:—August, 21·8, and September, 17·4, also at 29·9 ins. Then follow June, 19·7, February and March with 18·1, November, 12·8, and January, 12·7, all at 30·0 ins. May and April have 15·4 and 13·7 respectively at 30·1 ins. In October 12·1 occurs at both 29·7 ins. and 30·0 ins., while in December the maximum is 9·8 at 29·8 ins., the last month being, therefore, the one in which there is the greatest barometrical movement.

The seasonal results are exhibited in Table II. and in Fig. II. (Plate IV.) These show most markedly the variations in the aspect of the question in the different quarters of the year. In the first quarter the curve of frequency is long and low, indicating a maximum of range with a minimum number of readings at any particular point. In the third quarter the range is reduced to its lowest, but there is a gradual well-marked rise and fall of the curve from the extremes to a maximum at 29·9 ins., where the frequency attains its highest value of 21·1 per cent.

TABLE I.—Relative frequency of Barometric Readings at the Kew Observatory in different Months of the Year, derived from the Daily Means for the Ten Years, 1870 to 1879, and from Hourly Readings for the Five Years, 1875 to 1879. The numbers represent percentages of the whole number of Observations made in each Month.

Pressure.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.	
	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.
Ins.																								
28·5	0·3	..	..	..	..	0·1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·1
·6	0·3	..	..	..	..	0·4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·3	..	0·6
·7	..	0·1	..	..	0·7	0·5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	0·4	0·7	1·0
·8	1·0	..	0·4	0·4	0·7	0·8	..	0·4	..	..	..	..	..	..	..	..	..	..	..	..	..	0·4	0·7	0·7
28·9	0·7	0·2	0·4	1·1	..	0·6	0·7	0·9	..	..	..	..	..	..	..	..	..	..	..	0·2	1·0	0·8	0·3	0·8
29·0	1·0	0·6	1·1	1·9	..	0·6	0·3	0·7	..	..	..	..	..	..	..	..	0·3	..	0·3	0·2	1·0	1·7	0·7	0·8
·1	2·1	2·3	0·4	1·7	1·0	2·1	1·1	1·7	..	..	..	..	..	0·2	..	0·4	0·3	..	1·7	1·2	0·7	2·7	1·7	2·3
·2	0·7	1·0	1·1	2·0	1·7	3·2	1·1	2·3	0·3	0·8	..	..	0·3	0·6	0·3	0·6	..	0·4	3·7	2·8	4·5	4·0	2·4	2·6
·3	1·0	1·2	3·0	3·3	3·0	2·2	4·2	3·0	0·3	0·8	..	0·3	1·0	2·1	..	0·9	1·0	0·6	3·4	3·9	4·9	5·7	3·0	3·1
·4	3·8	2·6	2·6	5·3	3·0	2·8	3·9	7·1	1·3	2·3	0·3	1·9	1·7	3·4	2·0	5·1	1·7	1·9	5·0	4·0	6·3	6·8	3·4	6·3
·5	3·8	4·1	6·0	5·3	4·4	6·6	8·1	12·4	6·1	9·2	3·9	6·5	2·7	3·7	5·0	4·7	3·1	4·4	7·1	5·2	8·3	6·0	6·8	5·1
·6	6·6	5·1	6·7	5·9	5·7	10·1	8·8	10·8	8·8	8·0	6·0	7·2	4·1	6·6	6·0	9·2	8·7	9·2	6·4	9·1	5·9	5·7	7·8	8·4
·7	5·9	7·3	10·9	8·1	11·4	10·4	6·0	8·0	6·7	12·4	8·8	11·8	8·5	10·1	10·4	11·8	12·6	11·6	12·1	9·6	5·2	5·8	8·8	8·5
·8	11·0	7·5	9·0	12·4	11·7	10·7	10·6	9·6	12·8	12·0	16·2	18·6	14·0	14·5	16·8	21·4	11·9	13·1	10·1	11·0	9·7	8·5	9·8	9·1
29·9	7·9	10·6	10·5	11·5	11·4	8·6	12·3	11·8	11·1	10·5	17·6	20·2	23·9	20·3	21·8	20·8	17·4	17·1	11·4	11·8	8·0	11·1	8·1	7·5
30·0	12·8	13·8	13·1	12·3	13·1	10·4	12·3	10·3	13·5	11·7	19·7	18·7	17·1	13·6	16·4	12·6	14·3	15·3	12·1	8·2	12·8	11·5	7·4	6·7
·1	12·4	10·6	9·4	9·8	8·0	8·1	13·7	10·6	15·5	16·2	16·5	13·4	13·7	10·7	10·1	8·0	8·7	12·0	8·4	12·6	12·5	11·1	9·4	8·3
·2	7·9	12·3	9·7	6·9	6·7	6·1	8·4	5·1	13·5	9·0	7·4	1·3	8·2	8·9	8·1	3·6	10·1	10·1	7·7	10·9	5·2	7·7	6·1	3·7
·3	7·9	8·7	4·9	5·0	7·0	7·3	3·9	3·0	8·1	4·6	1·4	..	4·1	5·1	2·0	1·0	7·3	3·4	4·4	3·8	6·9	4·7	4·7	6·5
·4	5·9	5·8	4·1	2·3	6·4	4·7	2·8	1·7	2·0	2·4	2·1	..	0·7	0·1	1·0	..	1·4	0·8	3·7	4·0	4·2	3·2	6·4	8·9
·5	4·8	3·6	3·0	4·4	3·0	3·1	1·1	0·4	..	..	..	..	..	..	..	..	1·0	..	2·0	1·3	2·4	1·9	5·7	5·9
·6	2·1	2·5	2·6	0·4	0·3	0·4	0·3	..	..	..	..	..	..	..	..	..	..	..	0·3	0·2	0·3	0·1	5·1	2·0
30·7	..	..	1·1	..	0·7	..	0·3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1·0	1·0

TABLE II.—Relative Frequency of Barometric Readings at Kew Observatory in different Seasons and Half-years. The numbers represent percentages.

Pressure.	Dec. Jan. and Feb.		March, April and May.		June, July and August.		Sept. Oct. and Nov.		Mar. to August.		Sept. to Feb.		Annual.	
	Season 1.		Season 2.		Season 3.		Season 4.		Summer.		Winter.			
	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.	Daily Means.	Hourly Obsns.
Ins.														
28·5	0·1	..	..	..	..	..	..	..	..	..	0·1	..	..	..
·6	0·1	0·2	..	0·1	..	..	..	0·1	..	..	0·1	0·1	..	..
·7	0·2	0·4	0·2	0·2	..	..	..	0·1	0·1	0·1	0·1	0·2	0·1	0·1
·8	0·7	0·4	0·3	0·4	..	..	..	0·1	0·2	0·2	0·3	0·3	0·3	0·2
28·9	0·6	0·7	0·2	0·5	..	..	0·3	0·3	0·1	0·2	0·4	0·5	0·3	0·3
29·0	1·1	1·1	0·2	0·4	..	..	0·6	0·6	0·1	0·2	0·7	0·9	0·4	0·5
·1	1·4	2·1	0·7	1·3	..	0·2	1·0	1·3	0·3	0·8	1·2	1·7	0·7	1·2
·2	1·4	1·9	1·0	2·1	0·2	0·4	2·7	2·4	0·6	1·2	2·1	2·1	1·3	1·7
·3	2·3	2·5	2·5	2·0	0·3	1·1	3·1	3·4	1·4	1·6	2·7	3·0	2·1	2·3
·4	3·3	4·7	2·7	4·1	1·4	3·5	4·3	4·2	2·1	3·8	3·8	4·5	2·9	4·2
·5	5·5	4·8	6·1	9·4	3·9	5·0	6·2	5·2	5·0	7·2	5·9	5·0	5·4	6·1
·6	7·0	6·5	7·7	9·6	5·4	7·7	7·0	8·0	6·5	8·6	7·0	7·3	6·8	7·9
·7	8·4	8·0	8·1	10·3	9·2	11·2	10·0	9·0	8·7	10·8	9·2	8·5	8·9	9·7
·8	10·0	9·7	11·7	10·8	15·6	18·2	10·5	10·9	13·7	14·5	10·3	10·3	12·0	12·4
29·9	8·8	9·9	11·6	10·3	21·1	20·4	12·3	13·3	16·4	15·4	10·6	11·6	13·5	13·5
30·0	11·0	10·9	13·0	10·8	17·7	15·0	13·1	11·7	15·3	12·9	12·0	11·3	13·7	12·1
·1	10·0	9·6	12·4	11·6	13·4	10·7	9·8	11·9	12·9	11·1	10·1	10·7	11·5	10·9
·2	7·9	7·6	9·5	6·7	7·9	4·6	7·7	9·6	8·7	5·6	7·8	8·6	8·2	7·2
·3	5·9	6·7	6·4	5·0	2·5	2·0	6·2	4·0	4·4	3·5	6·0	5·4	5·2	4·3
·4	5·5	5·6	3·8	2·9	1·3	..	3·1	2·7	2·5	1·4	4·3	4·1	3·4	2·7
·5	4·6	4·6	1·4	1·2	..	..	1·8	1·1	0·7	0·6	3·2	2·9	2·0	1·7
·6	3·3	1·6	0·2	0·1	..	..	0·2	0·1	0·1	0·1	1·7	0·8	0·9	0·4
30·7	0·9	0·3	0·3	..	..	..	..	..	0·2	..	0·3	0·2	0·3	0·1

The curves for the second and fourth seasons present characters intermediate between the other two.

In the semi-annual curves the previous curves are still farther softened down, the principal feature worthy of note being that of the occurrence of the maximum in the summer half-year at 29·9 ins., and in the winter at 30·0 ins.

The final curve, which embodies the discussion of the whole of the observations, represents a beautifully smooth wave-like figure, gradually rising from a zero at 28·5 ins. up to a maximum percentage of 13·7 at 30·0 ins., whence it falls again to a minimum of about 0·3 per cent. at 30·7 ins.

There is a certain want of symmetry, however, about all the curves, for which, at present, I do not see my way to assign a reason. In every case the fall from the maximum is to a slight extent more abrupt than is the rise to it; the curve is also extended farther on the side of low barometer than it is in the direction of the higher readings.

Very low readings are so exceptional in their occurrence that perhaps they are scarcely worthy of consideration, for the daily mean has only stood at 28·5 ins. and 28·6 ins. once in ten years, that is, once in about 3,500 observations.

Readings at the other extreme of 30·7 ins. have been registered on 0·3 per cent. of the times, or about once every year; this degree of frequency is also found in the 28·8 ins. and 28·9 ins. observations.

With the view of determining to what extent the above conclusions as to frequency of barometer readings which are based upon daily means are affected, when applied to individual observations, I have discussed the hourly values of the barometric pressure at Kew, as given by the barograph, and published in the volumes of hourly readings at the seven observatories in connection with the Meteorological Office. Of these I have taken the five years' observations 1875-1879 inclusive, and treating the hourly readings in the same way as the daily means, have determined the percentage of recurrence at each successive tenth of inch of pressures between the extreme limits of 28·3 ins. and 30·7 ins.

The results are given in the Tables and Diagrams beside the others, and it will be found that the two sets of percentages agree very closely throughout, the general type of curve being preserved.

Certain differences found in comparing the curves for the separate months show that, in a few instances, the exact form of curve for the month is influenced considerably by the number of years of observation: notably in the case of April, where the hourly readings attain a maximum of recurrence at 29·5 ins., due to exceptionally large numbers of such readings in 1877 and 1879; and again in October, where readings at 30·1 ins. preponderate largely in the same years.

In both June and August the position of highest percentage slightly differs in the hourly and daily curves, but these differences do not affect it in the seasonal curves.

Comparing the two sets of results in detail, we find the range covered by hourly readings is 2·5 ins., viz. from 28·3 ins. to 30·7 ins., exceeding that of the daily means by three-tenths of an inch.

In the month of June, where the range was least, the readings extended from 29·3 ins. to 30·2 ins., *i.e.* through nearly 1 inch.

In a few instances in the different months barometer readings have been registered at points lower than those for which percentages are exhibited in the Tables, the limits of which are percentages of 0·05, that is to say, they include all cases where the reading has recurred more than once in two thousand observations.

The most noteworthy of these exceptions are in the case of 28·3 ins., which was registered for five hours in December 1876, and of 28·4 ins., which was twice noted in March of the same year.

The highest percentage of hourly frequency for separate months is 20·8, given by 29·9 ins. in July. In different seasons, we get 20·4 for the same point in the third season, for the summer half year the maximum frequency is 15·3, and it becomes 11·6 in the winter half. Finally, taking all observations discussed, we find that 13·4 per cent. of them, or, roughly speaking, one in every eight, is a reading between 29·90 ins. and 30·00 ins.

Possibly the above determinations of the relative frequency of barometric

readings may be of assistance to observers discussing sets of observations, in the case of any doubtful readings they may meet with. I should have liked to have been able to render the investigation more perfect by discussing a more lengthy set of hourly observations, but time has not permitted my doing so on the present occasion.

In conclusion, I have to express my thanks to the Kew Committee for having granted me facilities for the preparation of this brief Paper, and permission to lay it before the Society.

DISCUSSION.

Mr. MARRIOTT said that Mr. Whipple had forestalled him with the paper on the barometer, as he had been working at the same subject from the Greenwich observations, only his investigation extended over a much longer period, viz. 30 years, from 1848 to 1877. The following Table gives the percentages of the mean daily readings of the barometer from 28·6 ins. to 30·9 ins. The values in the *Greenwich Observations* are not reduced to sea-level, he had, therefore, merely increased all the readings by two-tenths of an inch.

Barometer Reading.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Ins.												
28·6	0·1	..	..	..	..	..	..	..	..	..	..	0·1
·7	0·1	..	..	..	..	..	..	..	..	..	..	0·0
·8	0·3	..	0·3	..	..	..	..	..	..	..	0·2	0·4
28·9	0·4	0·4	0·3	..	..	..	..	..	..	..	0·2	0·3
29·0	1·0	0·4	0·4	0·1	..	..	..	..	0·2	0·3	0·9	0·8
·1	1·7	0·7	0·8	0·2	..	..	..	..	0·2	0·8	0·8	0·4
·2	3·0	0·4	2·0	0·9	0·2	..	..	0·1	0·6	1·4	2·1	1·6
·3	2·2	1·2	2·4	1·3	0·4	0·2	0·1	0·3	0·8	2·3	2·2	2·4
·4	2·6	2·4	4·1	3·2	0·5	0·6	0·5	0·9	1·3	4·6	4·3	3·4
·5	4·2	4·6	3·4	3·8	1·8	1·0	1·2	1·5	3·3	5·6	4·2	4·9
·6	6·5	4·7	7·7	6·6	6·1	3·4	2·7	3·4	3·9	6·0	6·3	5·7
·7	6·3	7·1	8·9	7·4	7·7	7·1	5·5	4·2	6·1	8·8	6·3	7·3
·8	9·1	9·4	9·0	8·4	10·1	10·2	12·1	13·8	12·1	10·2	8·3	7·9
29·9	10·9	9·2	11·5	11·1	14·7	13·4	14·7	16·1	12·4	11·2	10·0	8·9
30·0	8·9	12·5	10·0	12·3	15·3	17·8	20·3	18·5	15·7	11·9	9·6	9·1
·1	10·3	10·2	9·4	13·8	14·6	16·9	19·9	18·5	10·3	11·8	11·7	9·7
·2	10·1	11·2	9·7	13·8	14·9	16·6	12·6	12·4	11·8	11·1	10·1	8·9
·3	7·6	9·0	7·0	9·9	9·0	8·0	7·3	6·7	10·1	7·3	9·7	10·3
·4	6·3	7·3	5·0	4·5	4·3	3·6	2·7	3·0	7·5	3·6	7·0	7·1
·5	4·2	4·3	4·2	1·9	0·3	0·9	0·4	0·6	3·0	2·5	4·1	5·7
·6	2·9	3·4	2·5	0·8	0·1	0·3	..	..	0·7	0·4	1·2	3·9
·7	1·1	1·3	0·9	..	..	..	..	..	..	0·2	0·5	0·9
·8	0·2	0·2	0·5	..	..	..	..	..	..	..	0·3	0·3
30·9	..	0·1	..	..	..	..	..	..	..	..	..	..

Mr. DINES thanked Mr. Whipple for the two papers before the meeting. He noticed that a new column headed "Thermometric Dryness" had been introduced into the Tables; if Mr. Whipple had given the difference between the dry and wet bulb readings only he should have considered it an improvement, but not so when that most uncertain element the difference of the dew-point and the air was introduced.

He had no intention of discussing the correctness of the methods by which the dew-point and relative humidity were obtained, his opinion on that point was well known; but he could not altogether help alluding to it, as on one point it had a direct bearing upon the question discussed in the first paper. The curve showing the diurnal changes of the barometer for the twelve hours of the day continued to rise till it attained its maximum about 10 a.m., falling to a minimum

at 4 p.m., then rising again. All the dew-point curves he had seen rose gradually till about 2 p.m., thus giving the highest dew-point, or greatest tension of vapour, about the same time as that of maximum temperature. Looking at the barometric curve, they all felt it was something on which reliance could be placed; not so with the dew-point curve; it would be a difficult matter for him to prove it was not correct, but he did not for one moment believe it to be so. He thought he could explain the cause which had produced this shape of curve; taking that room for example, and using the dry and wet bulb thermometers to obtain the dew-point, he found, as both thermometers increased in temperature, there was a tendency to give the dew-point higher than when they were lower, although the real dew-point might be the same in both cases. The dew-point curve was obtained by *calculation* from the continuous records of the dry and wet bulbs, and he thought it was due to the cause he had mentioned, that the highest part of that curve was made to correspond in time with that of highest temperature. Starting from the dew-point temperature, another Table had to be used before relative humidity could be obtained; this was called tension of vapour. Suppose the dew-point to be 50°, this gave the tension of vapour equal to a column of water about 5 inches high, and from this it had been assumed that if all the vapour in the air were condensed into water it would cover the ground to the depth of 5 inches—with a dew-point of 30° it would be 2¼ inches—and 70°, nearly 10 inches. Now, as to our knowledge upon this matter, supposing the dew-point to be obtained correctly, what then? if we went to a place where the trees were thicker it would be higher, and it frequently changed 4° to 5° in less time than it took to talk about it. In speaking of these changes, he must, however, except cloudy days with strong wind, when they did not occur. Now as to elevation: the dew-point was generally about 2° higher near the ground than at 4 feet above it, while at 50 feet above the ground it was about as much lower. He would go higher still: wherever cloud existed the air was saturated; but saturated air was lighter than drier air of the same temperature, and mixed with the vapour in the cloud was a quantity of water, and, so far as the few observations he had made extended, this amounted to from 1 to 2 grains weight per cubic foot; this water was so finely divided that it could not force its way downward through the air, or if it did so, it was at a very slow rate; but it answered this purpose, it weighted the cloud, kept it at the same level, and, so far as he could see, it would pass over the barometer without in any way affecting it. How could they estimate the amount of vapour and water combined in the clouds, when they neither knew their temperature nor depth; but could there be any doubt that the difference must be great, when the sky was clear and when it was covered with clouds a mile in depth?

These were his reasons for thinking that any theory which connected the height of the barometer with relative humidity must be received with great caution, as they really knew but little as to the amount of moisture in the air; for the same reason he objected to the columns of tension of vapour and relative humidity. They must all admit this question was not in a satisfactory state. His friend, Mr. Greaves, was not satisfied with the Tables. The whole question must soon come under revision, and they might then hope to know what the figures given were really intended to represent.

Dr. TRIPE said that if moisture had any effect on the amount of cloud at a given locality, then drainage by decreasing the moisture would also decrease the amount of cloud, and so increase sunshine. He thought that the smoke from London extended to Kew and formed at times an artificial cloud, and was, therefore, somewhat surprised at the Table not indicating such a result.

The PRESIDENT (Mr. Symons) thought it rather strange that after the placing of the words 'Change,' 'Fair,' &c., upon the scales of barometers had been generally abandoned, and so little attention paid to their position that symmetrical distribution of the lettering was regarded as of primary importance, their true meaning had again come before the Society. This, however, being the case, he had thought it of interest to try to ascertain when the words were first adopted and by whom. He was not in a position to speak positively upon the subject, for the earliest notice of them which he had found was in a pamphlet published, in 1688,* where they are thus given, "At 28 is ingraven *Great Storms*, at 28½

* Smith, John. A complete discourse of the Nature, Use and Right Managing of that wonderful instrument the Baroscope, or Quicksilver Weather-Glass, by J. S. 8vo. London, Printed for Joseph Watts, at the Angel in S. Paul's Churchyard, 1688.

Much Rain, at 29 *Rain*, at 29½ *Uncertain* or *Changeable*, at 30 *Fair*, at 30½ *Settled Fair*, at 31 *Very Dry*." Although he had not much actual evidence upon the subject, he (Mr. Symons) was inclined to think that these words were originally suggested by the Honourable Robert Boyle, who was one of—if not the first—to use a barometer in this country, and who had one fixed at his residence at Stanton St. John's, near Oxford, about 1660. Stanton is about 500 feet above mean sea-level, and as *Changeable* ought to be opposite to the mean height of the barometer (which in this country may be roughly taken as 30 inches), its being placed opposite 29·5 implies that the scale was adopted by some one resident at about the height of 500 feet. This, however, is only conjecture. A fact worth notice is that upon barometers made in France, not only is *Change* (*Variable*) put at 29·8 ins. or nearly in its proper place, but the entire scale is contracted—*Stormy* (*Tempête*) is put at 28·8 ins., and *Very Dry* (*Très-sec*) at 30·9 ins. This contraction of the scale agrees better with the range of the barometer in France than would the more open British scale. He did not believe that the amount of cloud was affected by the humidity of the soil beneath. He thought that a list of the extremes of temperature and pressure would be very valuable. There was a list of low barometer readings at Greenwich in the 'Quarterly Journal,' Vol. I., p. 200. He believed that Mr. Glaisher also gave a list of extremes of temperature at Somerset House, from 1775 to 1842, in the 'Transactions of the Royal Society for 1849;' and in the 'Meteorological Magazine,' Vol. XII., p. 184, will be found the highest and lowest temperature (and the dates thereof) at Greenwich for every month from 1841 to 1877, both inclusive.

Mr. Scott drew attention to the fact that Capt. Hoffmeyer had recently proposed that certain data should be regularly published for international and telegraphic stations, viz. Tables of monthly (or even ten-day) means for several elements and also of extreme barometer readings, and that he himself had opposed the granting the latter portion of the request, as he considered barometrical extremes, unless taken from barograms, to be misleading in many cases.

Mr. Whipple said that the effect of London smoke at Kew had been dealt with in his previous Paper on Sunshine.* He hoped to have an opportunity of making observations on the height to which the bank of London smoke extends. He had used the term dryness only because it was a convenient one. He thought that his surmise as to the possible relation between the moisture and the amount of cloud was accurate.

PROCEEDINGS AT THE MEETINGS OF THE SOCIETY.

November 17th, 1880.

Ordinary Meeting.

George James Symons, F.R.S., President, in the Chair

George Corden, 16 Wandle Road, Croydon;
Edward Theodore Dowson, Geldeston, Beccles;
Frederic Hepburn, B.A., Ramalho, Sutton;
Campbell M. Hepworth, Southampton;
Thomas Henry Goodwin Newton, M.A., J.P., Barrels Park, Warwickshire;
Moses Parry, Bryntirion Terrace, Criccieth, N. Wales;
Edward Picton Phillips, High Street, Haverfordwest; and
Henry Ling Roth, Mackay, Queensland,
were balloted for and duly elected Fellows of the Society.

The following Papers were read:—

"Table of Relative Humidity." By Edward Ernest Dymond, F.M.S. (p. 1.)

* Quarterly Journal, Vol. IV. p. 201.

"Rainfall in South Africa." By JOHN G. GAMBLE, M.A., M.Inst.C.E., F.M.S. (p 3.)

"The Meteorology of Mackay, Queensland." By HENRY LING ROTH, F.M.S. (p. 8.)

"Thermometrical Observations on board Ship." By Capt WARREN FREDERICK CABORNE, F.M.S. (p. 10.)

DECEMBER 15th, 1880.

Ordinary Meeting.

GEORGE JAMES SYMONS, F.R.S., President, in the Chair.

FREDERICK COVENTRY, Ketton Hall, Stamford;
JOHN WILLIAM MOORE, M.D., 40 Fitzwilliam Square West, Dublin;
WILLIAM THOMAS PAULIN, Broadfields, Winchmore Hill;
JAMES PORTER, 63 Fenchurch Street, E.C.; and
Capt. WILLIAM CHARLES SMITH, 150 Leadenhall Street, E.C.,
were balloted for and duly elected Fellows of the Society.

Mr. J. S. DYASON and Mr. C. HARDING were appointed Auditors of the Treasurer's Accounts.

The following Papers were read:—

"Report on the Phenological Observations for 1880." By the Rev. THOMAS ARTHUR PRESTON, M.A., F.M.S. (p. 13.)

"On the Variations of Relative Humidity and Thermometric Dryness of the Air with changes of Barometric Pressure at the Kew Observatory." By GEORGE MATHEWS WHIPPLE, B.Sc., F.R.A.S., F.M.S. (p. 49.)

"On the Relative Frequency of given Heights of the Barometer Readings at the Kew Observatory during the 10 years 1870-79." By GEORGE MATHEWS WHIPPLE, B.Sc., F.R.A.S., F.M.S. (p. 52.)

RECENT PUBLICATIONS.

ALLGEMEINE ERDKUNDE. EIN LEITFADEN DER ASTRONOMISCHEN UND PHYSISCHEN GEOGRAPHIE, GEOLOGIE UND BIOLOGIE. Bearbeitet von Dr. J. Hann, Dr. F. v. Hochstetter und Dr. A. Pokorny.

Mit 205 Holzstichen in Text, 15 Tafeln und einer geologischen Uebersichtskarte von Mittel-Europa in Farbendruck. Dritte neu bearbeitete Auflage. 646 pp. 8vo. 1881.

AMERICAN JOURNAL OF SCIENCE. Vol. XXI. January 1881. 8vo.

Contains:—Contributions to Meteorology: being Results derived from an examination of the Observations of the United States Signal Service, and from other sources. By Prof. Elias Loomis. Fourteenth Paper, with 3 Plates. The object of this Paper is to investigate the course and velocity of storm centres in tropical regions and also in the middle latitudes, and to deduce the causes which control their movements.

ANNALI DELL' UFFICIO CENTRALE DI METEOROLOGIA ITALIANA. Serie II. Vol. I. 1879. 746 pp. 4to.

The introduction gives an account of the organisation of the Italian Meteoro-

logical System and the appointment of the Commission, and also of the Agricultural and Telegraphic Services. Part I. is devoted to Papers by various authors, *e.g.* Gli Aneroidi Goldschmid, per C. Chistoni.—Sui confronti fatti a Collio fra l'igrometro Regnault e lo psicrometro a ventilatore, per C. Chistoni.—Sugli evaporimetri e sulla temperatura dell'aria, per G. Cantoni. Part II. contains the Results of Observations made at 78 Stations in Italy during the year 1879. Part III. comprises several Papers, chiefly on Astronomical Subjects. An Appendix gives the Observations made at the Observatorio del Collegio Romano for the twelve months December 1878 to November 1879.

ANNUAIRE DE LA SOCIÉTÉ MÉTÉOROLOGIQUE DE FRANCE. 28E. Anneé 1880. 1er et 2me Trimestres. 4to.

Principal contents :—Sur l'inscription des phenomènes météorologiques, en particulier de l'électricité et de la pression, par M. Mascart.—Sur la period diurne de l'électricité atmosphérique, et du courant tellurique ascendant, par M. D. Ragona.—Considérations sur les explorations aériennes à de grandes hauteurs, par M. L. Tridon.—Note sur l'hiver de 1880, par M. E. Renou.—L'hiver de 1879-1880, à Clermont et au Puy-de-Dôme, par M. Alluard.—Variations de la température avec l'altitude pour les grands froids de décembre 1879 dans le bassin de la Seine, par M. G. Lemoine.—Sur l'interversion des températures de l'air avec la hauteur, par M. C. André.—Du froid produit par le vent, par Dr. Fines.—Répartition de la température suivant l'altitude, (hiver de 1879-1880) par M. le comte Sansac de Touchimbert.—Essai d'une théorie provisoire des hydromètres, par M. C. Ritter.—Prévisions relatives à la tenue des eaux courantes dans le bassin de la Seine, pendant l'été et l'automne de la présente année, par M. G. Lemoine.

ANNUAIRE DE L'OBSERVATOIRE DE MONTSOURIS, pour l'an 1881. Météorologie, Agriculture, Hygiène. 24mo.

Contains among other information :—Tables psychrométriques.—Observations météorologiques anciennes faites à Paris.—Météorologie agricole, par Dr. Marié-Davy.—Resumé météorologique des années agricoles 1873-1880, par M. L. Descroix.

CIEL ET TERRE. REVUE POPULAIRE D'ASTRONOMIE ET DE MÉTÉOROLOGIE. Nos. 17-22. November 1880 to January 1881. 8vo.

The chief meteorological articles are :—La mesure de la Pluie, par J. Vincent.—Les pluies sur l'Océan Atlantique.—Le Baromètre, que mesure-t-il ? par F. Van Rysselberghe. The author proposes the following definition : Le baromètre mesure la tension atmosphérique résultant de l'ensemble de toutes les forces qui agissent sur l'atmosphère *dans le sens vertical*.—La pluies et les inondations. par J. Vincent.

CLIMATE AND HEALTH IN SOUTH AFRICA. By James Bonwick, F.R.G.S. Revised by W. C. Burnet. 8vo. 1880.

The work is arranged under the following subjects :—Climate and Health in South Africa ; South African Thirsty Lands, Karroo Land, Bushman Land, Namaqua Land, Kalihari Desert ; South African Rains ; Cape Town Climate ; Climate of the South west Districts ; The South-east Climate ; The Mountain Land Climate ; The Eastern Side of South Africa ; Natal ; Zululand Climate ; Transvaal Climate ; The Orange River Free State Climate ; The Diamond Fields Climate ; and Health in South Africa.

LONDON FOGS. By the Hon. R. Russell, F.M.S. 8vo. 44 pp. 1880.

The author divides the subject into three parts, viz. 1. The Characteristics of London fog and haze, especially in relation to weather ; 2. The damage to health and property by smoke and soot in the air ; and 3. The means of prevention.

MEMOIRS OF THE LITERARY AND PHILOSOPHICAL SOCIETY OF MANCHESTER. Third Series. Vol. VI. 8vo. 1879.

Contains :—Certain lines observed in Snow Crystals, by A. W. Waters.—On an instrument for measuring the direct heat of the Sun, by Prof. B. Stewart,

LL.D., F.R.S.—On the manner in which raindrops and hailstones are formed, by Prof. O. Reynolds, M.A.—On the formation of hailstones, raindrops, and snow-flakes, by Prof. O. Reynolds, M.A.

NOVA ACTA REGIÆ SOCIETATIS SCIENTIARUM UPSALIENSIS. Series III. 1880. 4to.

Contains :—Marche des Isotherms au printemps dans le Nord de l'Europe, par H. Hildebrand Hildebrandsson. With 5 plates.

PROCEEDINGS OF THE ASIATIC SOCIETY OF BENGAL. June 1880. 8vo.

Contains :—Note by H. F. Blanford to accompany some drawings of large Hailstones, by Col. H. H. Godwin-Austen and S. E. Peal. Two stones weighed 700 and 720 grains respectively, and measured 5½ and 6 inches in circumference.

PROCEEDINGS OF THE MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY. Vol. XIX. Session 1879-80. 8vo. 1880.

Contains :—Recording Sunshine, by D. Winstanley.—On a new form of marine Rain Gauge, by W. J. Black.—The Radiograph, by D. Winstanley.—On the Rainfall adjacent to the Sweetloves Reservoir, Sharples, for 1879, by Rev. T. Mackereth.—A curious Rainbow, by E. W. Binney, F.R.S.—On the long period inequality in Rainfall, by B. Stewart, F.R.S.

PROCEEDINGS OF THE ROYAL SOCIETY. Vol. XXXI. Nos. 207-208. 8vo.

Contains :—Report of the Kew Committee for the year ending October 31, 1880.—On Actinometrical Observations made in India at Mussooree and Dehra in October and November 1879, by J. B. N. Hennessey, F.R.S.

REPERTORIUM FÜR METEOROLOGIE HERAUSGEGEBEN VON DER KAISERLICHEN AKADEMIE DER WISSENSCHAFTEN. Redigirt von Dr. Heinrich Wild. Band VII. Heft 1. 4to. 1880.

Contains :—Ueber Beobachtung der Richtung und Stärke des Windes auf Schiffen, von M. Rykatschew.—Die Vertheilung der Winde über dem Weissen Meere, von M. Rykatschew.—Die Abhängigkeit der Stärke und Richtung des Windes von der Grösse und Richtung des Gradienten an den Küsten des Baltischen Meeres, von J. Spindler.—Ueber den jährlichen Gang der Verdunstung in Russland, von E. Stelling.

REPORT OF THE METEOROLOGICAL COUNCIL TO THE ROYAL SOCIETY, for the Year ending 31st of March, 1880. 8vo. 1881. pp. 118.

In addition to the Report on the work of the Office, this contains three papers by Prof. G. G. Stokes, F.R.S., viz. :—(1) On the effect of sluggishness on the readings of marine barometers on shore ; (2) A description of the card supporter for Sunshine Recorders adopted at the Meteorological Office ; and (3) On the use of the Harmonic Analyser for meteorological reductions ; also a preliminary note on the methods available for the determination of the humidity of the atmosphere.

SITZUNGSBERICHTE DER KAISERLICHEN AKADEMIE DER WISSENSCHAFTEN. II. Abth. Nov-Heft. 1880. 8vo.

Contains a paper by Dr. J. Hann : Die Vertheilung des Regenfalls über Oesterreich in der Periode von 11-15 August 1880 und deren Beziehung zur Vertheilung des Luftdruckes.

THE ROSARIAN'S YEAR-BOOK FOR 1881. Edited by the Rev. H. Honywood D'Ombrain. 8vo. 1881.

Contains :—On the effect of severe winter on the unripened wood of the rose, by G. Baker.—The weather of the past rose year, by E. Mawley.

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES. Conducted by ALEXANDER RAMSAY. Climate. Vol. I. Part 1. No. 1. 8vo. 1880.

In the Introduction the author states that his plan is to thoroughly search each paper or volume, and arrange its contents under specified headings classified

according to a definite order. This Part contains an Essay on the Diurnal Periodicity, and also a General Bibliography which gives notices of books arranged chronologically up to 1830.

ZEITSCHRIFT DER OESTERREICHISCHEN GESELLSCHAFT FÜR METEOROLOGIE. Redigirt von Dr. J. Hann. XV.-XVI. Bande. November 1880 to January 1881. 8vo.

Contains:—Die Winde in den mittleren und höheren Breiten der südlichen Halbkugel, von Dr. P. Andries.—Daniel Colladon: Contributions à l'étude de la grêle et des trombes aspirantes.—Ein Beitrag zur Morphologie der Gewitterwolken, von Dr. J. Hann.—Die Regenverhältnisse des Atlantischen Oceans nach den Beobachtungen deutscher Schiffe, von Dr. W. Köppen und Dr. A. Sprung.—Nordlichtbeobachtungen, ausgeführt in Norwegen, Schweden und Dänemark.—Ueber eine neue Quellentheorie auf meteorologischer Basis, von Dr. J. Hann.—Wagebarograph mit Laufgewicht, nach Sprung.—Einige Resultate meteorologischer Beobachtungen aus dem Gebiete des Indischen Oceans, von Dr. A. v. Danckelman.

QUARTERLY JOURNAL

OF

THE METEOROLOGICAL SOCIETY.

VOL. VII. No. 38.

THE HISTORY OF ENGLISH METEOROLOGICAL SOCIETIES, 1823 TO 1880, BEING THE ADDRESS DELIVERED AT THE ANNUAL GENERAL MEETING, JANUARY 19TH, 1881. BY G. J. SYMONS, F.R.S., President.

I AM very glad to be able to say that the most difficult duty which it has fallen to my lot to discharge as your President has been to decide upon the subject of my Address; for no stronger proof could be afforded of the harmonious manner in which the Council discharge the considerably increased duties which fall upon them. It is needless to say that my difficulty arose from plethora, and not from the reverse. I have found it hard to resist the temptation to collect together such fragments as I could, and trace the progress of meteorological knowledge from that possessed by the Greeks and Romans down to the present time; but that would, perhaps, have been beyond my power, and certainly could not have been efficiently treated in the hour to which, by wise custom, your President's Address is limited.

This, and various other day-dreams, have been put aside, because I have come to the conclusion that the most generally useful appropriation of my time will be to devote it to the consideration of the history and labours of this Society since its foundation in 1850, and of the Meteorological Society of London, out of which it partly grew. This will necessarily bring all branches of meteorology before us; will remind us of some investigations which have been completed and forgotten; of some of which many of our Fellows have not heard; and of some which, being incomplete, will, I trust, be taken up again, either by their authors or by other Fellows, and carried through to their legitimate conclusion.

The earliest English effort at forming a Meteorological Society, or at any rate at securing observations made with comparable instruments, recorded upon a uniform system, was made in 1723 by Dr. James Jurin, who was then Secretary to the Royal Society. In the '*Philosophical Transactions*' for that year (p. 422) will be found an able Latin Address, by Dr. Jurin, which is far too long to quote, but in which he anticipates nearly all the conditions which we now consider essential for comparable observations.

This appeal did not lead to much being done, and 20 years later, on May 8, 1744, another attempt was made by Mr. Roger Pickering, F.R.S., who read before the Royal Society a paper, entitled "Scheme of a Diary of the Weather, together with draughts and descriptions of Machines subservient thereunto." From this paper I quote the first two paragraphs:—

"A sense of the importance of observing the weather induced *Hippocrates*, in his remarks upon the epidemic diseases in *Thasos*, to premise a general history of the weather preceding them; and with the same view did our great Mr. Boyle turn his thoughts so closely upon the same subject; whose example, being followed by several judicious inquirers into Nature, both abroad and at home, has brought the *Natural History* of the *Air* to a surprising degree of perfection, beyond what the Antients ever could pretend to, or even thought of. Had but each county in *England* gentlemen of such sentiments who would charge themselves with the annual trouble of sending a regular account of the *weather* to this *learned body*, by it to be compared and digested, to what degrees of accuracy may we not suppose a knowledge of the nature and affections of the *atmosphere* may be brought; and how well may we not hope to be guarded against the disorders which as *islanders* we are exposed to, by such a close inquiry into the nature of that necessary fluid in which we breathe! not to mention the advantages which several important branches of trade may receive from such measures; and were the digested observations of the *R. Soc.* compared with those of foreign societies, formed upon the same plan, how short a time would bring this part of Philosophy to the greatest degree of demonstrable certainty.

"The trouble of making and keeping such *meteorological registers*, which, in all probability, prevents several gentlemen from performing this piece of service to the public, might be rendered very inconsiderable, by the proposal of an easy, as well as comprehensive, method for a *diary*, and a set of simple and convenient *machines* for making the necessary observations."

I must not allow myself to be tempted to discuss this paper fully, but may add that the rain gauge in appearance remarkably resembles the earlier pattern of Storm rain gauge brought out by me as a novelty some ten or fifteen years ago; and the anemometer is evidently copied from that proposed, it is believed, by Robert Hooke, in the Instructions to Seamen in 1667 (*Phil. Trans.*, Vol. II., p. 153). It resembles closely those devised of late years by Prof. H. Wild, and by the late Dr. Prestel, of Emden. Wild's anemometer was originally constructed for use at the Swiss Stations, and has since been introduced extensively at the Russian Stations and elsewhere The principle of the instrument is that a vane brings a suspended plate perpendicular to the wind, and the force of the wind is measured by the extent to which the plate is blown from a perpendicular towards a horizontal position. This instance is, however, hardly as striking as the fact that Mr. S. Gray, of Canterbury, in May, 1698, used to read his barometer by means of a cathetometer, similar in general outline to the one erected at Kew Observatory about 20 years since.

This ingenuity in the construction of instruments, and these repeated appeals for observers, produced but little effect; for I do not think that a single new station was started within 20 years after Mr. Pickering's paper was published. The Royal Society did not even begin its own register until 80 years afterwards, or 1774, and then it was short lived, for after 1781 the observations were neglected for several years. This was all the more remarkable, as it was in that very year that the Society received the invitation to join the Meteorological Society of the Palatinate in their grand and very successful organisation. Prof. Daniell in his '*Elements of Meteorology*,' gives so fair and concise a history of this organisation, that instead of writing a fresh one I quote his account:—

"My friend, Mr. Howard, some time ago obliged me with a loan of some of the volumes of the *Ephemerides of the Meteorological Society of the Palatinate*: a work which, if it had been continued with its original spirit to the present time, would probably have left little to be desired in the way

of observation; and which, even in its present state, would be found by the diligent inquirer to contain more *data* for a correct history of European weather than all other works upon the same subject taken together. During a tour which I made in Germany, I succeeded in obtaining a complete copy of these Transactions, from their commencement in 1781 to their termination in 1792. As this record is very little known in this country, and in its complete state very scarce, I shall be excused for giving a short account of its origin, and that of a society which might undoubtedly afford the most perfect model of a similar institution at the present day for promoting the Science of Meteorology.

"The Meteorological Society of the Palatinate was established in the year 1780, under the auspices of the Elector Charles Theodore, who not only gave it the support of his public patronage, but entered with spirit and ability into its pursuits, and furnished it with the means of defraying the expense of instruments of the best construction, which were gratuitously distributed to all parts of Europe, and even to America.

"One of the first acts of the Association was, to write to all the principal universities, scientific academies and colleges, soliciting their co-operation, and offering to present them with all the necessary instruments properly verified by standards, and free of expense.

"The offer was immediately accepted by 80 societies; and the list of distinguished men who undertook to make the observations shows the importance which was attached to the plan, and the zeal with which it was promoted in every part of the Continent. Amongst those who, for the good of science, undertook and executed this daily drudgery, we find the names of Hemmer, Weis, Plann, Senebin, Bugge, Van Swinden, König, Catte, Egel, Pictet, Toaldo, and Euler.

"The Secretary Hemmer appears to have been indefatigable in his exertions to perfect this truly princely plan of operations; and even now, but little could be added to the precautions taken in the preparations of instruments which he describes, or to the ample instructions for their use which he transmitted with them. Some idea may be formed of the comprehensive scale of the register, when it is known that it contains observations, three times in the day, of the barometer, thermometer, in the shade and in the sun, hygrometer, magnetic needle, direction and force of the wind, quantity of rain and of evaporation, the height of any neighbouring water, the changes of the moon, the appearance of the sky, and the occurrence of meteors and of the Aurora Borealis. To these must be added, in some places, observations upon the electrical state of the atmosphere, upon the progress of vegetation, the prevalence of disease, changes of population and migration of animals.

"The field of observation extended from the Ural Mountains in the East, to Cambridge in the United States in the West; and from Greenland and Norway in the North, to Rome in the South. This range included also stations upon three high mountains in Bavaria, and upon the summit of St. Gothard.

"The observations of each year are summed up and compared with those which precede in copious and most laborious tables of mean and extreme results; and many very interesting essays upon various branches of meteorology are interspersed throughout the volumes. Unfortunately for science the Secretary Hemmer died in the month of May, 1790, and from that time the Society appears to have languished, and finally to have become extinct amidst the troubles and the wars of the French Revolution."

In the next paragraph Professor Daniell falls into a great error: he says that in these Mannheim volumes he found "the first exemplification of the

method of representing the oscillations of the barometer by a curved line upon a scale." This is rather a droll error for an F.R.S., for if he had read only the publications of his own Society he would have found there a copper plate engraving of a barometer diagram for the whole year 1683-4, based upon observations made at Oxford by Dr. Plot; and although this method is called "plotting," I am not sure that the term is based upon the name of Dr. Plot, for Dr. Plot was not the originator of the method—that credit attaches to the name of Dr. Lister, President Roy. Soc.

I pass over 40 years, from 1781, when the Royal Society allowed its register to be neglected, and when it failed to respond to the wise and handsome offer of the Meteorological Society of the Palatinate, and I come down to 1823. But although up to that time there existed no Meteorological Society or Association of any kind, I do not wish to imply that there were no series of observations being made; there were many, *e.g.* I possess 26 perfect records of the fall of rain in the year 1791, 20 for England, five for Scotland and one for Ireland—and at several of these stations barometric and thermometric records were kept—but there was no uniformity, no combination.

THE METEOROLOGICAL SOCIETY OF LONDON.

In the '*Monthly Magazine*' or '*British Register*' for February 1, 1823 (Vol. 55, p. 70), in a notice of a meteorological record kept during a voyage to and from the southern hemisphere, the Editor said, "Those general principles of the science of *Meteorology*, which yet, unfortunately, are wanting, and towards the attainment of which it seems to us surprising that no special society has yet been formed."

Two months later—viz. in the number for April 1, 1823 (Vol. 55, p. 207)—the following letter appeared:—

"To the Editor of the '*Monthly Magazine*.'

"Sir,—Among the numerous societies established in London for the encouragement of the arts, the improvement of the sciences, and the diffusion of knowledge, it had often excited my surprise that a Meteorological Society had not been formed; it was therefore with very great pleasure that I found that you had experienced similar feelings. Allow me therefore to call the attention of the meteorologists of the metropolis and its vicinity to the propriety of forming such a society, which I have no doubt might be easily effected, and would be ably supported.

"Of the increased interest which meteorological subjects have lately obtained, the latter numbers of your Miscellany are sufficient evidence; and the improvement of the science would be the necessary result of the association of persons either skilled in, or attached to it.

"Placed under the management of an active committee, and patronised, as it would most probably be, by some of the first characters of the country for rank and talent, the society must flourish; and there can scarcely be a town or large village in the kingdom which would not afford a correspondent, who would be willing to transmit his observations to the society; and thus many phenomena, which had been observed by some retired meteorologist, would become publicly known, and receive the attention which might be due to them.

"Through the numerous tables which would be obtained by these means, the temperature, dryness, or humidity, of different places would be more accurately known, and the observations would be rendered of more value, if made (under the recommendation of the society) with instruments of the

same construction, and under circumstances as nearly similar as possible. From registers thus formed, the meteorologist would receive information and pleasure, the man of science amusement, and the valetudinarian benefit, by being able to select a residence where the climate suited his constitution,—a thing of no small consequence, and no little difficulty in the variable temperature of our native isle.

"JAMES G. TATEM.

"Harpenden, St. Albans, February 20, 1823."

Six months later, the first meeting of the Meteorological Society was held, and I am glad to be able to give a full report of the proceedings and of the resolutions then adopted; but as it would be very wearisome to read to you the details of each meeting, I have given them fully in an appendix, and will endeavour to treat only of the general history of the society. As regards this first meeting, it was held on October 15, 1823, at the London Coffee House, Ludgate Hill; it was attended by Luke Howard, Thomas Forster, Dr. Birkbeck, and others, and was chiefly devoted to passing resolutions regarding the formation of the society, the terms of membership, &c. Meetings were held monthly throughout the session, which lasted till May 12.

During this session I believe the following is a nearly perfect list of the members. Although very short, it contains many names which will not soon be forgotten:—

Adams, R.
Allen, W., F.R.S.
Birkbeck, Dr. (Founder of Mechanics' Institutes.)
Bostock, John, M.D., F.L.S.
Brayley, E. W., Jun. (Afterwards of London Institution.)
Brodie, B. C., F.R.S. (Afterwards Sir Benjamin Brodie.)
Clutterbuck, H., M.D.
Colby, Col., R.E. (Director of Ordnance Survey.)
Daniell, J. F., F.R.S. (Professor, King's College, and Inventor of Hygrometer.)
De la Beche, H. T., F.R.S. (Afterwards Sir Henry, and Director of Geological Survey.)
Forster, E.
Forster, Thomas, M.B., F.L.S. (Author of *Atmospheric Phenomena*, &c.)
Harrison, Dr. E.
Howard, Luke, F.R.S. (Author of *Climate of London*, &c.)
Patterson, G. M., M.D.
Pepys, W. H., F.R.S.
Pereira, J.
Roberts, C. J., M.D.
Shearman, W., M.D.
Taylor, Richard, F.L.S.
Wilford, T. (Secretary.)

After 1824 the Society languished, partly owing, perhaps, to the removal, about this date, of Luke Howard from Tottenham to his Yorkshire residence at Ackworth, near Pontefract. It was never regularly dissolved, but after about 1830 the Treasurer, Dr. Clutterbuck, declined to receive any more subscriptions. The expenditure of the Society up to this time had, however, been very trifling. One lithograph circular is the only publication of the Society belonging to this period known to me. Although therefore the greatest number of members had perhaps not exceeded 30, it is not remarkable that both money and a fair supply of books had been accumulated.

I can hardly believe that nothing was done between 1824 and 1832; but I can find no record of anything until the autumn of 1832, when several meetings were held, at one of which, on August 1, Dr. Birkbeck was appointed Treasurer in place of Dr. Clutterbuck resigned, and another held on August 27, when the late Treasurer reported that, all liabilities being discharged, he had a balance of £66, and a general meeting of the Society was convened to be held September 25, 1832, at the Mechanics' Institute, Southampton Buildings—

(1.) To authorise the Treasurer to purchase £75 New 3 per Cents.

(2.) To authorise the Council to offer two prizes of £50 and £25 Stock respectively for the best and second best essay on some subject of meteorological research to be chosen by the Council.

The summons for this meeting is signed by the original Secretary (Mr. T. Wilford), and it may have been his last act in connection with the Society, for shortly afterwards he became ill, went to Madeira, and died there.

Excepting that the money was invested as proposed, I have been unable to ascertain what was done at that meeting; and during the subsequent four years I can trace no action on the part of the Society, except that the new Treasurer (Dr. Birkbeck) continued to draw the dividends on the above mentioned stock.

During the year 1836 several letters and articles appeared in "Loudon's *Magazine of Natural History*" dwelling on the desirability of meteorological observers combining for the purposes of mutually promoting the advancement of the science; several of these letters were by a Mr. W. H. White, who, during the following six or seven years, will be found to have taken an active part in the work of the Society. Another of the writers was Mr. J. G. Tatem, who, as we have already seen, may be regarded as the founder of the first Society. Mr. White seems to have been ignorant of the existence of the original Society, and even Mr. Tatem says, "I was or am a Member of the Meteorological Society founded in 1823;" and then he goes on to explain that he uses the queer expression "I was or am" because he did not know whether the Society was in existence or not—had or had not been dissolved; all he did know was that the Treasurer had refused his proffered subscription. Later on, however, he received a letter from Dr. Birkbeck, who, writing as President, said, "The Meteorological Society of London has not been dissolved; but has only sunk into a state of rest, not from the want of pecuniary means to effect the objects of the Society, as some have imagined, but, apparently, from a want of zeal in some of the members to carry into effect various important objects."

On November 15, 1836, a meeting was held at which the Society was revived, Mr. W. H. White was appointed Secretary, and regular meetings were resumed. I have collected from very various sources records of what was done at these meetings, and I am glad to say that the record of Proceedings is much more nearly complete than I had the remotest expectation of making it. I do not pretend to give references, for that would be too laborious, but I may say that besides the publications quoted in the Bibliography in the Appendix, and besides the MSS. in the Library of the Meteorological Society, I have drawn upon Loudon's *Annals*, the '*Literary Gazette*,' the '*Britannia*' the '*Gardeners' Gazette*,' the '*Athenæum*' and I think one or two other serial works. Where dates are given, but no details appended, the date is that fixed for a meeting at which I can find no record of what was done. During the Session 1836-7 thirty members joined the Society, among them one who afterwards, unfortunately for meteorology, turned his brilliant talents in another direction, I mean John Ruskin, of whom I shall have to speak again.

For the ensuing season 1887-8 regular cards of meetings were issued and the Society became more systematically worked.

In the early part of the year 1888 several men of great eminence joined the Society, *e.g.* Capt. Sir John Ross and Sir J. F. W. Herschel, both of whose names appear on the Council in 1838 and 1839, but I cannot find that they attended any of the meetings. At this time also a very energetic and perhaps able, but certainly not prudent, young man joined the Society and immediately assumed a prominent position on its council.

Mr. R. C. Woods being engaged in the manufacture of Meteorological instruments, naturally felt the importance of the Society possessing standards of its own; and hence induced the Council to order £50 worth, the chief item being 40 guineas for a "large standard barometer with glass cistern containing 70lbs. of mercury, with attached thermometers and extra mountings," which barometer was said to give readings corrected for capacity, capillarity and temperature! This barometer was far behind the period at which it was made, for Fortin's pattern had been engraved two years previously in the '*Penny Cyclopædia*,' and Jones's, with leather bag and ivory point had been known for nearly twenty years—I may as well finish the history of this barometer at once. Three years after it was made, the Society sold it for the value of the mercury it contained. It was emptied of its 56 lbs. (not 70 lbs. as stated) of mercury, and the frame was put into store. Finding that Mr. Casella still had it, I asked him to send it down for examination this evening, and he desired me to say that it was quite at the disposal of the Society if the Fellows cared to preserve so eccentric, if historic, an instrument. In his name, therefore, I have the pleasure of presenting it to the Society.

This expenditure for instruments and sundry smaller items naturally led to the sale, on August 7th, 1838, of £50 out of the £75 stock.

Application was made to the Royal Society for permission to compare the Instruments of the Meteorological Society with the Royal Society Standards, and leave was granted on March 30th, 1838.

Up to this time, however, nothing had been printed, and on February 9th, 1838, one of the original members complained that "the Society has been revived 15 months, and all that the members have received is a book of rules." But the Council were preparing a volume of *Transactions*, although it was not published until March 25th, 1839. A copy of this is already in the Society's Library, and it is not at present at all an expensive book to buy, although it was originally published at two guineas. The frontispiece to this volume is entitled 'Tabulæ Meteorologicæ, 1837,' and is a marvellous piece of engraving; it must be seen to be understood, and therefore I must dismiss it with a very few words. It is circular, about 2 feet across, it contains the daily observations throughout the whole year at eight stations, the information respecting each day forms a radius of the circle, and as there are 360° in a circle and 365 days in a year, it is obvious that practically the arc appropriated to each day amounts to 1°. There is a regular series of symbols for the state of weather, the direction of the wind is given by letters, and the pressure and temperature by curves, different kinds of lines being appropriated to each station.

As to the book itself, there is no denying that it was, on the whole, a creditable production. As a copy is in the Society's Library and therefore accessible to all the Fellows, I will mention only one point which might be overlooked by casual readers. There is an article entitled "Remarks on the present state of Meteorological Science, by John Ruskin, Esq., of Christ-Church College, Oxford," from which I must quote two paragraphs, written, be it remembered, nearly half a century since.

"There is one point, it must now be observed, in which the science of

meteorology differs from all others. A Galileo, or a Newton, by the unassisted workings of his solitary mind, may discover the secrets of the heavens, and form a new system of astronomy, A Davy in his lonely meditations on the crags of Cornwall, or, in his solitary laboratory, might discover the most sublime mysteries of nature, and trace out the most intricate combinations of her elements. But the meteorologist is impotent if alone; his observations are useless, for they are made upon a point, while the speculations to be derived from them must be on space. It is of no avail that he changes his position, ignorant of what is passing behind him and before; he desires to estimate the movements of space, and can only observe the dancing of atoms; he would calculate the currents of the atmosphere of the world, while he only knows the direction of a breeze. It is perhaps for this reason that the cause of meteorology has hitherto been so slightly supported; no progress can be made by the enthusiasm of an individual; no effect can be produced by the most gigantic efforts of a solitary intellect, and the co-operation demanded was difficult to obtain, because it was necessary that the individuals should think, observe, and act simultaneously, though separated from each other, by distances, on the greatness of which depended the utility of the observations.

"The Meteorological Society, therefore, has been formed, not for a city, nor for a kingdom, but for the world. It wishes to be the central point, the moving power, of a vast machine, and it feels that unless it can be this, it must be powerless; if it cannot do all, it can do nothing. It desires to have at its command, at stated periods, perfect systems of methodical, and simultaneous observations; it wishes its influence and its power to be omnipresent over the globe, so that it may be able to know, at any given instant, the state of the atmosphere at every point on its surface. Let it not be supposed that this is a chimerical imagination—the vain dream of a few philosophical enthusiasts. It is co-operation which we now come forward to request, in full confidence that, if our efforts are met with a zeal worthy of the cause, our associates will be astonished, *individually*, by the result of their labours in a body. Let none be discouraged, because they are alone, or far distant from their associates. What was formerly weakness, will now have become strength. Let the pastor of the Alps observe the variations of his mountain winds; let the voyager send us notes of their changes on the surface of the sea; let the solitary dweller in the American Prairie observe the passages of the storms, and the variations of the climate; and each, who alone would have been powerless, will find himself a part of one mighty Mind—a ray of light entering into one vast Eye—a member of a multitudinous Power, contributing to the knowledge, and aiding the efforts, which will be capable of solving the most deeply hidden problems of Nature, penetrating into the most occult causes, and reducing to principle and order, the vast multitude of beautiful and wonderful phenomena, by which the wisdom and benevolence of the Supreme Deity regulates the course of the times and the seasons, robes the globe with verdure and fruitfulness, and adapts it to minister to the wants, and contribute to the felicity, of the innumerable tribes of animated existence."

I make but one comment on these paragraphs. They show you the view of Meteorology taken not by *a* Ruskin, but by *the* Ruskin.

There are many other remarks in the volume which call for comment, but I must pass them all. I may, however, just mention that the use of the dry and wet bulb thermometer is recommended, and the establishment in every country of a central Government Meteorological Office, and a description is given of the enamelling the back of thermometer tubes. This is based upon a letter from Mr. Woods, dated September 4th, 1838, where he says:—

"I have introduced a narrow streak of white enamel a little wider than the bore of the tube, immediately behind the thermometer, but forming a part of the glass cane."

Any one who is familiar with the cost of printing and will examine this volume of Transactions, will readily see that it must have been very costly. The expense was to be borne jointly by Messrs. Smith, Elder, & Co. and the Society, the latter undertaking to purchase 100 copies, *i.e.* to pay £210 for them, but eventually Messrs. Smith, Elder, & Co. agreed to accept 25 per cent. less, or £157 10s. 0d. The Society had been spending very freely, and had been looking rather to the number of names on the list of Members than to the regularity with which they paid their subscriptions. With however apparently little heed to the load of debt resting upon them, the Council in June, 1839, took rooms in Bartlett's Buildings, Holborn, moved their large barometer there (costing another £5), and continued their meetings. But Mr. Woods had gone abroad, Lieut. Morrison (Zadkiel) was influential with the Council; Mr. W. H. White, the Secretary, also devoted much time to planetary, &c., influence; and for two or three years the Society seems to have done little except print 58 pages of Proceedings, sell out the remainder of its capital, and pay the publishers of the Transactions £10, out of their claim of £157. About this time, however, three new names came to the front, viz. that of one of the Presidents of our own Society (Dr. Lee, F.R.S.), who for some years held at intervals the office of Treasurer, Lord Robert Grosvenor, now Lord Ebury, who accepted the Presidency, and for several years rendered great assistance to the Society, contributing observations, supplying funds, personally presiding over the meetings, and offering much private hospitality to the Council, and lastly Mr. J. W. Gutch, who became Treasurer and continued in office till the dissolution of the Society.

Under Mr. Gutch's auspices the Society resumed publication and issued in 1840 the *Proceedings* of Sessions 1838-40. In this year also the Society, although much in debt, took rooms at Bedford Street, Covent Garden.

During 1841 Mr. Gutch was arranging for the issue of the '*Quarterly Journal of Meteorology*,' of which the first number appeared January 1, 1842, and in which will be found the prototypes of the tables subsequently compiled for so many years for the Registrar-General by Mr. Glaisher. Mr. Gutch undertook personally the pecuniary risk of this publication, except that the Society undertook to obtain 200 subscribers, an undertaking which it did not carry out. And I ought here in fairness to state that many of the difficulties of the early Society are distinctly traceable to the absence of those postal facilities which we now enjoy, without realising their immense utility. The Post-office has done as much to foster science as the British Association itself. That however is a digression. Shortly before Midsummer, 1842, the Society moved again, this time to 17 Old Bond Street, and the meetings were fairly well attended, but the Society was adding to its liabilities, Mr. Gutch was losing by every number of the '*Quarterly Journal*,' and so in the summer of 1843 the '*Quarterly Journal*,' and the meetings of the Society, ceased. Here, however, to the great credit of many of the members, the history of the old Society does *not* end. It was in debt something like £200, and a number of the members, at the suggestion of Lord Robert Grosvenor and Mr. Gutch, paid subscriptions for three or four years in advance, so that I believe the Society at its dissolution had discharged the whole of its liabilities.

MINUTES OF PROCEEDINGS OF THE METEOROLOGICAL SOCIETY OF LONDON 1823—1843.

SESSION 1823—24.

1823, October 15. A meeting was held at the London Coffee House,

Ludgate Hill, on Wednesday, the 15th instant, to take into consideration the propriety of forming a Meteorological Society. Among the gentlemen present were Drs. T. Forster, Clutterbuck, and Shearman, Mr. Luke Howard, &c.: at eight o'clock the chair was taken by Dr. Birkbeck, when the following resolutions were agreed to:—

1. That the formation of a Society to promote the advancement of Meteorology, have the cordial approbation of this meeting.
2. That a Society be formed to be called "The Meteorological Society of London."
3. That the business of this Society shall be conducted by a President, Vice-Presidents, Treasurer, Secretary and Council; and that the number of Vice-Presidents and members of the Council be determined at a subsequent meeting.
4. That Mr. Thomas Wilford be requested to officiate as Secretary to this Society (*pro tempore*), and that he be authorised to send a printed summons to attend the next meeting to each person who shall become a subscriber.
5. That an annual subscription of two guineas be paid in advance by every member of this Society.
6. That those gentlemen present who are inclined to become members of this Society, do now send their names to the Secretary to be enrolled.
7. That a Committee of three members be appointed in conjunction with the Secretary, to draw up an account of the Society's proceedings this evening.
8. That scientific men throughout the United Kingdom be solicited to co-operate with this Society, and to transmit communications to it; and that this Society will always be ready to receive meteorological observations from the cultivators of science throughout the various quarters of the globe.
9. That no other qualification be required to constitute eligibility to this Society than a desire to promote the science of Meteorology.
10. That after the next meeting the election be by ballot upon the proposition of three, and that a majority of members decide.
11. That this meeting do adjourn to the 12th of November next, to meet at the same place and hour.

1828, November 12. The second general meeting was held in pursuance of the resolutions agreed to on October 15, and was very numerously and respectably attended.

Dr. Birkbeck having been called to the chair, the business of the evening commenced by the admission of a number of new members, among whom were W. Allen, F.R.S.; W. H. Pepys, F.R.S.; B. C. Brodie, F.R.S.; H. T. De la Beche, F.R.S.; G. M. Paterson, M.D., M. Asiat. Soc. Calcutta, &c.

The Society then proceeded to the election of a Council and Officers; when the following gentlemen were appointed:—

President.—George Birkbeck, M.D., M. Ast. Soc., M.G.S., &c.

Council.—John Bostock, M.D., F.R.S.; Thomas Forster, M.B., F.L.S.; William Shearman, M.D.; C. J. Roberts, M.D.; Luke Howard, F.R.S.; J. F. Daniell, F.R.S.; Richard Taylor, F.L.S.; E. W. Brayley, jun.

Treasurer.—Henry Clutterbuck, M.D.

A provisional draft of regulations for the government of the Society having been read, it was referred to a committee for revision, and the Society then adjourned.

1824, January 14. The third general meeting was held, and the code of regulations, as revised by the Committee, was adopted by the Society.

The meeting was then resolved into an ordinary one, and the Committee appointed by the Council to consider and report upon the best means of establishing correct and complete series of Meteorological Observations presented their preliminary report. They urged that the first and principal object of the Society was to obtain accurate and comparable observations of atmospheric phenomena from all parts of the world; and after adverting to the advantages which would result from the general adoption by meteorologists of instruments graduated upon the same scales, to be examined by all at the same hours, and the results noted upon the same plan, they proceed as follows:—

"The Committee are, however, aware that there are many and weighty difficulties in the way of such an arrangement, and that much time would necessarily be required for their consideration and discussion; they therefore recommend that immediate measures be taken to procure correct registers of comparable observations from different parts of Great Britain and its colonies, as well as from other parts of the world, with instruments graduated to the common scales. To effectuate this purpose with advantage, they consider it absolutely necessary that the Meteorological Society of London should set the example of the requisite precision by establishing a Meteorological Observatory in the metropolis, or its vicinity, and instituting operations to be conducted with undeniable accuracy, and with instruments of standard excellence."

A paper was also read "On the Natural History and probable Causes of the Vernal Winds of the North of England, as they prevail in Westmoreland;" by John Gough, of Kendal. This paper was, sixteen years afterwards, printed in Vol. I. of the *Transactions*, p. 67.

1824, February 11, and 1824, March 10. The following papers were read:—Dr. Burney, "On the Results obtained at Gosport Observatory;" Luke Howard, F.R.S., "On some curious Effects of the Radiation of Heat;" and Dr. Thomas Forster, "On the variations of the Reflective, Refractive and Dispersive powers of the Atmosphere." Time did not allow the reading of this paper to be concluded, and it was therefore resumed at the meeting on March 10. After some general remarks Dr. Forster proceeded to divide his subject, and to ascribe the daily and seasonal variation in the refractive power of the atmosphere chiefly to the quantity and nature of the aqueous vapour diffused in the air, supporting that opinion by various astronomical observations. In observing the planets and brightest stars through prisms, he found the spectrum less oblongated, whilst the red colour was more distinctly apparent, at the period of the vapour point [I suppose this means at the time of greatest humidity] than at almost any other time of the same nights. On other occasions, at the same period of evening, the violet and in general the colours of the most refrangible rays were most conspicuous and the spectrum was more oblongated than ordinarily. Dr. Forster at length ascertained that the greater prevalence of red in the spectrum, uniformly accompanied that state of the atmosphere when the *cirro-stratus* diffused itself, after sunset; while the more oblongated spectrum, with the violet and most refrangible colours, attended an atmosphere in which the condensing vapours assumed the form of *stratus*. He inferred from these and other observations that the changes in the qualities of the diffused vapour in the air must produce great variation in the atmospherical refraction. In the second section of his paper he suggested that local circumstances may produce great variation in the mean refractive power of the atmosphere at different places; and that thence the discordances in the places assigned to the fixed stars in different catalogues may have arisen. In the third section, entitled "Of Varieties in the Com-

position and Nature of the Light of different Stars, considered as still further varying the Effects of Atmospherical Refraction, Reflection and Dispersion," Dr. Forster detailed a number of minute observations upon these varieties, inquired into their causes, and concluded by relating experiments upon the decomposition of the light of the moon, the planets, and certain fixed stars.

Dr. Forster also read a note upon a remarkable local intensity of frost, between January 14 and 15, 1820, at Hartfield, near East Grinstead, Sussex. At 10 p.m., on the 14th, an outdoor Fahrenheit thermometer exposed to NE was at zero, and at 11 p.m. at —5°. Some time between 1 and 8 a.m. on the 15th the temperature fell to —10° as shown by a Six's thermometer, it then gradually rose, and at midnight of 15th-16th it was 28°. A thermometer exposed to the NW indicated 1° higher on each occasion. Dr. Forster received only one notice of a distant observation, viz. one of zero *indoors* at Canterbury, and it was reported at the meeting that the same point was reached *indoors* at Hatfield.

[To this I may add that at Bromley-by-Bow and at Plaistow the temperature out of doors only fell to zero, and at Tottenham the lowest point was —0°·5, at Greenwich, according to Belville (but whether from his own observation, or from one by Robertson, I do not know) the lowest reading was 8°. At Thetford, Norfolk, the minimum was reported to be 7°.—G.J.S.]

1824, April 14. At this meeting Luke Howard, F.R.S., read a note "On certain Phenomena of the late cold weather."

1824, May 12. The concluding meeting of the session was held, and E. W. Brayley read "An account of the Principal Phenomena of Igneous Meteors which were observed in 1823."

There is here an interval of twelve years, during which I can find no record of any public meetings of the Society.

SESSION 1836—37.

1836, November 15. Meeting held at the Mechanics' Institute, Southampton Buildings—Dr. Birkbeck, President, in the Chair. The first resolution was "That the Society resume its meetings." Owing to the length of time since the previous meeting, there were several vacancies on the Council; the following elections therefore took place:—Mr. C. Shearman, as Treasurer, vice Dr. Clutterbuck resigned; and Mr. W. H. White as Secretary, vice Mr. T. Wilford, now resident in Madeira.

Rules as to the admission of members were passed.

Dr. Birkbeck read a very interesting paper by Prof. H. W. Dove, of Berlin, "On the various Winds and their causes."

1836, December 18. Dr. Birkbeck in the Chair. Several members elected, and communications were read respecting the hurricane of November 29th from Dorset, Buckingham, Bedford, Warwick, Belfast, Edinburgh, &c.—In Dorsetshire it was terrific, in Warwickshire slight, and in Edinburgh it was not felt. The evidence collected went to show that "it was a species of whirlwind, which had passed over the Atlantic in the form of an elliptic or parabolic curve."

1837, January 10. Meeting at Mechanics' Institute.

1837, February 14. Meeting. Paper read by Mr. Ruskin, "On the formation and colour of such Clouds as are caused by the agency of Mountains." Except the statement that this Paper contained the results of observations made in Switzerland, no record of it has been found.

1837, March 14. Anniversary Meeting. Dr. Birkbeck in the Chair. No report read, nor any Papers of importance. The only thing done seems to

have been the reading of a new set of rules, which were adopted and ordered to be confirmed at the next meeting.

1837, April 11. Meeting.

1837, May 9. Meeting at Mechanics' Institute. Dr. McIntyre in the Chair. Two members elected. A Paper was read by Capt. (afterwards Admiral Sir) John Ross, "On the Winter of 1837, in Wigtownshire," in which he stated that, though severe everywhere else, it had been exceptionally mild there; he had had great difficulty in filling his ice house.

1837, June 13. Meeting at Mechanics' Institute. Dr. Birkbeck in the Chair. This being the last meeting of the Session, an *interim* report was read, whence it appeared that since the revival of the Society in November 1836, thirty new members had joined, and nearly 50 Papers had been read.

SESSION 1837–38.

1837, December 12. Meeting at Mechanics' Institute. Dr. Birkbeck in the Chair. This meeting was chiefly devoted to examining the new standard instruments made expressly for the Society's own observations, and for verifying the instruments of the observers throughout the country. The barometer was described as follows:—

"The Society's Standard barometer (made by Mr. Cameron*) is a magnificent instrument, the proportion of the calibre of the tube to that of the cistern being as 1:50; a proportion which at once obviates the correction of capillary attraction. The thermometer and hydrometer have been constructed with equal care."

1838, January 9. Meeting at Mechanics' Institute, Mr. C. Shearman in the Chair. A Paper "On the meteorology of the Island of Teneriffe," lat. 28° 37′ N, long. 16° 15′ W, by Lieut. Grey (Associate Member of the Society) in charge of the Australian expedition, was read.

"The Island of Teneriffe," says Lieut. Grey, "is of volcanic origin; and as its famed peak is at the present moment, and has been since the island was known to Europeans, in a state of solfatara, I entertained a hope that if a series of observations had been made they might possibly throw some light upon the influence that volcanic action exercises upon atmospheric phenomena."

Lieut. Grey ascertained that the late Dr. Savinon, of Laguna, a town on the Island of Teneriffe, about 1,800 feet above the level of the sea, and three miles from the shore, had made a series of thermometrical observations during a period of eight years (from 1811 to 1818 inclusive) without an interruption of a single day, from which observations a mean of the whole year was obtained of 62°·7 Fahr., and 68°·7 Fahr. the mean of July, the month of Lieut. Grey's visit to the island.

The quantity of rain which fell at Teneriffe in 1812 was 19·88 inches, of which 5·24 inches fell in January in twenty-four hours. In 1818, 25·22 inches.

In Dr. Savinon's MSS. the following particulars are recorded of a tempest of wind and rain which visited the Canary Islands in the night between the 7th and 8th of November, 1826. In the Island of Teneriffe alone (though much damage was done in all the islands) there were 311 houses destroyed and 114 houses ruined, 248 persons killed, and 1042 animals destroyed. Thus may be seen the fury with which these storms sometimes rage.†

1838, February 13. Meeting. Dr. Lee in the Chair. One member

* But it bears the name of R. Carr Woods as maker.

† See *Transactions Meteorological Society*, Vol. I. p. 78,

elected. This meeting is memorable as the one at which the first enamelled tube thermometer was exhibited. It is thus mentioned—"Among the new inventions was an improved *thermometer*," by Mr. R. C. Woods, calculated to show the temperature at any hour of the night without the aid of artificial light; and then it is further described in detail as follows:—

"This instrument contains a narrow streak of white enamel, introduced into the cane of the thermometer immediately behind the tube."

A Paper was also read, by Mr. J. G. Tatem, "On the extraordinary severity of the frost of January, 1838, at High Wycombe." The mean temperature of the month was 25°·6, which was 8°·8 below the coldest of the previous 14 years. The lowest temperature was 1° on the night of the 19th, *i.e.* on January 20th, according to modern record.

1838, March 18. Anniversary Meeting. Dr. Birkbeck in the Chair. Two members elected. The Report stated the Society to consist of 56 members, besides Associates and Honorary Members—to be in every respect in a flourishing condition, and that 58 Papers had been read at the meetings during the session. [I think that their number must have largely exceeded their importance.] About 80 volumes had been presented to the Society, and also some valuable instruments. Several Papers were read, but, probably, the most important was one by Mr. Marshall, of Kendal, "On the Temperature of January, 1838." The mean temperature of the month was 80°·6, being the lowest for at least 15 years. The minimum temperature occurred three times—viz. 16° on the 18th, 19th, and 20th. In Sheffield on the 20th the temperature fell to —5°.

1838, April 10. Dr. Birkbeck in the Chair. Four members elected. An interesting Paper, "On the cold of January last, as experienced at Brussels," communicated by Prof. Quetelet, Secretary to the Royal Academy of Brussels, was read by the Secretary. The extreme cold, which occurred on the 20th of the month, was 5° Fahr. This was the coldest January since 1823, the lowest point of which was stated by M. Quetelet to be 1½° Fahr. M. Crahay noticed the thermometer at Maestricht on the same day to stand at 9½° below zero.

A short Paper was next read from Prof. Wartmann, Geneva, giving an account of an atmospheric bow, which was seen on the 12th February, 1837, in perfectly serene weather; it exhibited all the colours of the rainbow in a very distinct manner, but it did not appear in a vertical position like the ordinary rainbow, but inclined to the plane of the earth; it did not partake in any degree of the nature of a halo. It became visible at 5 minutes past 10 a.m., the sun shining with all its brightness, and lasted till 45 minutes past 10 a.m. It was not accompanied by any parhelia, nor was there any appearance of cloud till half-past 11 a.m., when a few light clouds were seen passing in the superior strata of the atmosphere; the afternoon was overcast without rain.

1838, May 8. Meeting. Dr. McIntyre in the Chair. One member elected. Several Papers read. Mr. S. Marshall, "On the Rainfall of Kendal, compared with that in other places." The author gave the following as mean values:—Kendal 57 inches, Plymouth 46½, Lancaster 45, Ludguan Penzance 41, Selborne, Hants, 37, Liverpool 34, Manchester 33, Nottingham 32½, Chichester 32, Bristol 29, Chatsworth 27½, Ferriby (North Lincoln) 27, Norwich 25½, London 23.

The author called attention to the general agreement of these values with what might have been expected considering that our great supply of vapour comes from the Atlantic, and considering also the condensing properties of mountain ranges. Mr. Marshall also called attention to the fact that great

rainfalls usually took place over hard geological formations, and pointed out that if that were not the case serious injury would have resulted.

The other Paper was by Mr. R. C. Woods, and was entitled, "Directions for making Meteorological Observations on Land or at Sea." [This Paper seems to me rather a disingenuous *réchauffé* of Sir John Herschel's *Instructions for making and registering Meteorological Observations.*]

A remarkable, but certainly not very scientific instrument, was exhibited by the maker—this same Mr. Woods; it was a standard thermometer for the observer at High Wycombe; it was 8 feet long, had a brass scale divided to tenths of degrees Fahrenheit, and *contained about three pounds of mercury!* The report does not say how long this tremendous bulb required to come to the true temperature.

1888, June 19 (instead of 12). Dr. Birkbeck in the Chair. One member elected. Dr. Lee presented a series of eight years' consecutive observations, kept at his seat at Colworth, Beds. [Now in our Library.] A letter was read from Sir John Herschel, recommending that the solsticial observations be made for only 25 hours instead of for 37. Lieut. Morrison described a storm in London on May 31, which he had "predicted from the square of the Sun to Jupiter." I may here remark that although the Society did not itself publish any Astro-meteorological Papers, the Secretary, Mr. White, did so, and, as the above shows, Lieut. Morrison was allowed to bring forward his own views. There is evidence to show that these facts seriously damaged the Society, more than one member resigning on that account.

SESSION 1888—89.

1888, November 18. Mr. J. Reynolds in the Chair. A Paper was read by Messrs. C. Green and Rush, "On results obtained in three Balloon Ascents." Mr. Green considered that usually the upper current is from NW. The greatest speed at which he ever travelled was 97 miles in 58 minutes, but 60 to 80 miles per hour was not unusual. A Paper was also read by Mr. J. H. Maverly, of Gosport, "On the Philosophy of the Aurora Borealis," in which he called attention to its relation to magnetic disturbances, and also stated that "the effects of aurora boreales are rain and wind, which generally come on within 24 hours after their disappearance."

1888, December 11. Dr. Lee, F.R.S., in the Chair. One member elected. "On the abating of the E wind with the declining sun, and on an increase of the wind in tidal rivers just before high water," by Mr. J. G. Tatem. The object of this Paper was merely an inquiry as to the cause of the above occurrences. Mr. Tatem stated that during the seven years prior to December 31, 1887, the wind at High Wycombe blew from the eastward on 240 days, 93 of which were in the four winter months, and in all these cases he believed that the violence abated about or after sunset, and the breezes returned again after sunrise next day. "On a Lunar rainbow on July 29, 1888, by Mr. R. C. Woods,* the only noteworthy feature was that the moon had only just passed its first quarter. Lunar rainbows are rare, except at or near full moon.

"On a remarkable Storm of Wind at Dundee, October 11, 1888," by Mr. W. Gardiner, junior. [This seems to have been so similar to the Tay Bridge storm that I quote the report *verbatim.*] "This gale reached its maximum between 6 and 8 p.m., when it blew a perfect hurricane in fearful gusts. The streets were strewed with chimney-cans, slates, tiles, &c., and houses unroofed. At Aberdeen the gale was most violent from 4 p.m. till midnight, with torrents of rain. A woman was killed by the storm near Huntly

* *Transactions Meteorological Society*, Vol. I. p 128.

(Aberdeenshire). At Stonehaven (Aberdeenshire) the storm was accompanied by hail; the chimney stalk of the gas works was blown down, and scarcely a stack of corn left standing. Along the banks of the Urie and at Fetteresso, and Dunnottar, Kincardineshire, great numbers of trees were either broken or torn up by the roots. At Bervie the slates and tiles were blown down, windows battered in, and doors and gateways of inclosures torn from their hinges. At Montrose the stately and beautiful suspension bridge was destroyed.* At Arbroath the chimney stalk of a machine manufactory was levelled with the ground. At Kirriemuir, Forfar, the spire and four or five feet of the steeple of the Episcopal chapel were blown down. At Cupar five houses were unroofed, trees torn up, and corn was scattered about. At Edinburgh a chimney on the Castle Hill fell, and four or five vessels were lost on the coast."

1839, January 8. Dr. McIntyre in the Chair. Mr. J. H. Maverly read a paper "On the peculiar weather at Gosport in December, 1838." The most noticeable feature was a violent hailstorm, agglomerated masses of clear ice, some nearly an inch in diameter, and others between two and three inches long. It was considered that about 8,000 panes of glass were broken in Gosport and the vicinity. The Secretary submitted a table, based upon Captain Back's observations in 1836 and 1837, made between lat. 59° 50′ and 65° 49′ N, and between 17° 46′ and 88° 44′ W, from which it appeared that the mean temperature of the winter months was —14°.

1839, February 12. Dr. McIntyre in the Chair. Two members elected. Papers, mostly unimportant. Mr. Gutch reports mean results for Swansea, but as he had observations for only a very few years (three, I think) they are of little value.

1839, March 12, Anniversary Meeting. Dr. McIntyre in the Chair. The Annual Report was read, but is *not* printed in the Proceedings. The following papers were read:—"Summary of Meteorological Observations at Malwan, in India, and at Ootacamund, on the Neilgherry Hills," by Major Gervis, F.R.S. This was based on observations during the four years, June 1, 1829, to May 31, 1832. The station was 7,300 feet above sea level, and the mean temperature for the four years was 55°·8. This summary was accompanied by a very important table showing a continuous series of observations, made hourly, day and night, during a period of seven months. "On the effect of the frost of January, 1839, upon vegetation at Alton, Hants," by Mr. W. Curtis, jun. From this paper it appeared that young plants suffered much less injury than old ones, and that laurels were generally killed nearly to the ground, except upon the highest and most exposed situations, where they were scarcely injured at all.

1839, April 9. Dr. McIntyre in the Chair. Two members elected. Several papers read, and the only one claiming notice is as a curiosity, "On the original and proximate cause of rain," by Lieut. Morrison. I only report this as a neat specimen of hypothesis run mad. "In this paper it was shown that the quantity of water evaporated exceeds the quantity fallen in the shape of rain, in the ratio of 100 to 83. And in order to account for the remaining 17 per cent. Lieut. Morrison said it appeared to him that as the law of decomposition of water by the electric fluid is proved to be in

* This word is rather too strong. According to 'Wilson's *Imperial Gazetteer of Scotland*,' this bridge was 432 ft. between the piers, 26 ft. wide, and cost £20,000. During a fearful gale in October, 1838, about two-thirds of it was torn up, destroyed, and thrown into the river, but the main chains were uninjured, and the roadway was reconstructed on an entirely new and substantial plan by Mr. J. M. Rendell, C.E., at a cost of £8,000.

exact ratio of the quantity of electricity which traverses the water, and as electrical currents are known to exist in the atmosphere, and must therefore traverse the water suspended therein, much of that water becomes decomposed; and while the hydrogen ascends to perform its task in the superior regions, the oxygen descends to supply that demand which animal and vegetable existence necessarily create." I need not waste time in pointing out that this wonderful superstructure rests upon nothing. We do not know *now* the ratio of total rainfall to total evaporation, and most certainly they did not know it forty years ago.

1839, May 14. Dr. Lee, F.R.S., in the Chair. Two members elected. Four papers read, but they call for no report.

1839, June 11. Lord Robert Grosvenor in the Chair. Three papers read, but none of general interest.

SESSION 1839—40.

1839, November 12. Dr. Lee, F.R.S., in the Chair. The whole of the time of the meeting seems to have been devoted to examining the schedules and diagrams sent in by the observers during the previous vacation.

1839, December 7, Dr. Lee, F.R.S., in the Chair. Four members elected. "On a Lunar Rainbow on October 15th, 1839, at Aylesbury," by Mr. T. Dell. The moon was at the time seven days old, and the author called attention to that fact as a further proof that lunar halos occur at other epochs than that of a full moon. "On a Double Lunar Rainbow seen at Gosport at 7.30 p.m., on September 19, 1839," by Mr. J. H. Maverly. The moon was 11 days old; the extent of the interior bow was given as 77° 30′, the legs cutting the horizon at N 58° 30′ W and N 19° E, the altitude of its centre was about 27°, that of the moon, about 15°. The extent of the exterior bow was 96°, altitude 85½°. This is a very rare phenomenon.

1840, January 14. Papers read "On Coloured Solar Halos," by Mr. J. H. Maverly, and "On Meteorological Observations made at Fort Confidence, Great Bear Lake." The mean temperature for 1838 was 19°·6, max. temperature in June 75°·5; min. temperature in January —30°. Aurora very frequent.

1840, February 11. Dr. Lee, F.R.S., in the Chair. One member elected. The most important paper was sent by Mr. Pendergrass, being a "Summary of Meteorological Observations at Pool Cottage, Hereford, from 1818 to 1839." This Table, with some additions, is printed in the *Quarterly Journal of Meteorology*, p. 168.

1840, March 10. Dr. Lee, F.R.S., in the Chair. Two members elected. The Annual Report stated that twenty new Members and Associates had been elected, that eighteen papers had been read at the meetings, twenty volumes, and many serial publications had been received from different parts of the world, the total expenditure had been £36 18s. 10d., and the abstract of the Proceedings had been written up and prepared for the press. Council and Officers were elected and the meeting closed.

1840, April 14. Dr. McIntyre in the Chair. One member elected. The Secretary read a paper entitled "A few remarks on a Rain Table and Map," by Mr. J. Atkinson, of Harraby, near Carlisle. This was the first English rainfall map, and is very scarce. For a long time I was unable to procure a copy, and there is not one in the British Museum; I have however finally obtained three, and one is now in the library of the Society. It is a lithographic map of England and Wales and the South of Scotland, on the scale of 60 miles to an inch, and, therefore, about 7 inches square, and has

figures representing the mean fall of rain placed against 52 stations. The majority of the values are nearly correct, but a few are very wild, *e.g.* "Milbury, Oxfordshire, 48," but there can be no part of Oxfordshire with such a fall; and again "Cameron, Fifeshire, 61," which is at least double the true value.

At this meeting it was resolved that addresses should be drawn up for presentation to the Queen and H.R.H. Prince Albert upon the occasion of their marriage.

A committee was appointed to examine the archives of the Society and prepare a catalogue of the observations therein contained.

1840, May 12. Dr. Lee, F.R.S., in the Chair. Mr. S. L. Kent read a paper "On the weather in April, 1807" (*sic.*) This paper dealt chiefly with the electric state of the air, and the most important notes refer to some Lancashire thunderstorms on the 20th, 21st, and 22nd. A girl and some sheep were killed, and a mill was set on fire by lightning. The storm was also very severe in Derbyshire, at Bakewell some hailstones were 4 inches in circumference, and at Heckelton pieces of ice were picked up more than 4 inches long.

1840, June 9. Lieut. Morrison in the Chair. Mr. Leach made some remarks respecting the differences of temperature arising from the different mounting of thermometers; he submitted a number of readings, some from thermometers divided on boxwood and others upon their own stems, but it was suggested that the values given must be due to the substances used to support the thermometers, the differences being too large to be wholly due to mere mounting. Lieut. Morrison exhibited a new Anemoscope in which those present seemed so interested that they resolved upon holding an extra meeting in a fortnight to consider further improvements in it.

1840, June 23. Extra meeting, Lieut. Morrison in the Chair. The Anemoscope was again considered, and is reported as adapted for either sea or land, but I can find no hint as to its nature. Mr. Higgins proposed the erection of a Meteorological and Astronomical Observatory near London, especially with a view to the education of the Mercantile Marine; he thought that the scheme could be carried out by a company with about £1,000 in £10 shares.

SESSION 1840—41.

1840, November 10. Lieut. Morrison, R.N. in the Chair. After acknowledging donations and electing one member, the meeting seems to have been wholly devoted to examining the schedules of observations forwarded by the observers.

1840, December 8. Dr. McIntyre in the Chair. Evening devoted to acknowledging presents, comparing schedules, and to a discussion on the causes of barometric fluctuations.

1841, January and February. Owing to the severity of the weather, and to the great sickness among the members, there was no quorum at either meeting.

1841, March 9, Anniversary Meeting. Dr. McIntyre, V.P., in the Chair. The Report announces the removal of the place of meeting from Bartlett's Buildings, Holborn, to the rooms of the Botanical Society, Bedford Street, Covent Garden, and that the increased rent could easily be met were fewer of the members in arrear; states that "a synopsis has been published of the papers and MSS. in the possession of the Society" [No copy of this is known to me]; states that the Proceedings of the past Session will be printed forthwith, and that the Library has received many important additions.

Lord Robert Grosvenor, M.P., was elected President, and Mr. J. W. G. Gutch, Treasurer, a position which he held until the final collapse of the Society. The remaining £25 of stock was ordered to be sold, Lord Robert Grosvenor advanced £30 on the security of the barometer, and some of the most pressing liabilities were to be paid off.

1841, April 13. Lieut. Morrison in the Chair. A paper by Mr. H. Lawson, F.R.S., of Hereford, was read, describing his thermometer stand and pointing out its advantages. This paper was printed in the '*Quarterly Journal of Meteorology*,' (pages 22-23 and 420-421), and therefore need not be further mentioned. After the reading of this paper Mr. G. Leach gave a minute verbal description of the stand used by him at St. John's Wood, but no record of its pattern has been preserved.

1841, May 11. Lieut. Morrison in the Chair. The Treasurer, Mr. Gutch, read "An abstract of Remarkable Phenomena which have occured in England and in various parts of the Globe, during a period of more than one thousand years, viz. A.D. 220 to the present time." This is one of the best Meteorological Chronologies of which I am aware. It contains lists of Frosts, Heavy Rains, Snows, Storms, Whirlwinds, and Meteors—these last are terribly mixed up with auroræ and remarkable flashes of lightning – but altogether the chronology, which occupies 84 octavo pages, is a very good one. It will be found in the *Quarterly Journal*, page 134. A short and far inferior paper of a somewhat similar character, by Mr. Whistlecraft, was also read.* And the prospectus of the *Quarterly Journal of Meteorology* was ordered to be issued.

1841, June 8. Dr. Lee, F.R.S., in the Chair. Seven members elected, among whom was one whom we still have with us as a Fellow of the present Society, viz. Mr. L. P. Casella. The papers read were—Lieut. Morrison "On the winds of April and May, 1841," H. Lawson "Further Improvements in Thermometer Stands." A very long discussion ensued as to what should be considered the Meteorological day—*i.e.* whether it should divide (astronomically) at noon, or (civilly) at midnight, and it was eventually resolved that it should be the twenty-four hours which constitute the natural day and the following night, *i.e.* from sunrise to sunset.

1841, July 16, Mr. J. W. G. Gutch in the Chair. Three members elected. The papers read were, Lieut. Morrison "On the extraordinary fall of the barometer on July 10." According to him the fall in London in 24 hours was 0·760 in.; at Birmingham the fall during the same time was 0·744 in. Mr. J. H. Maverley sent a paper "On the severe Thunderstorm of May 27th, 1841." The author stated that the storm travelled from the eastern part of the English Channel across Surrey, Sussex, Middlesex, Bucks and Oxford into Gloucestershire. The greatest damage occurred at Windsor, where five cows were killed by lightning and some thousands of pounds worth of glass were broken by the hail. At the close of the meeting the members proceeded "to inspect a beautiful instrument invented by Mr. W. Pole, C.E., which combines the two hygrometers of Mason and Daniell, so that by the help of sliding verniers, the dew-point, force of evaporation, quantity of moisture in the atmosphere, &c., may be seen at a single glance, and without the usual calculations."

1841, September 22. Mr. J. Reynolds, in the Chair. Five members elected. Resolved, that in future there shall be no vacation, but that the Society meet on the second Tuesday in each month throughout the year. Resolved, also, that the Society begin to publish a *Quarterly Journal* on January 1, 1842.

* *Quarterly Journal*, p. 28.

SESSION 1841—42.

1841, October 12. Mr. J. W. G. Gutch in the Chair. The Secretary, Mr. W. H. White, read a paper describing the results of Mr. Weekes's electrical apparatus extending over the town of Sandwich, Kent, showing many very remarkable coincidences of electric action in the atmosphere and the peculiar positions of the planets during each day in the month of September last. Mr. P. L. Simmonds presented to the Society a variety of notes on the Meteorology of the Colonies. Mr. W. H. White read a short notice of the *Upasian Winds* which were felt at New Orleans from 23rd to 28th July, 1841. These are NE winds, said to bring "Death on their wings," to be the precursors of epidemic diseases, and if they continue long to produce most disastrous effects.

1841, November 9. Mr. J. W. G. Gutch in the Chair. Papers read:—"Meteorological Observations at Thwaite, Suffolk," by Mr. Whistlecraft.* "On the Rainfall July to October, 1841, at High Wycombe," by Mr. J. G. Tatem. The author found the total 6 inches above the average of the previous 18 years. "On the Rainfall and Evaporation at Hereford," by Mr. H. Lawson, F.R.S. Mr. Lawson lost the observations for 1834, but, omitting that year, he gives values for each year, 1826 to 1840, both inclusive. Of the figures as given in the *Quarterly Journal* the following are the results:—

Rain.		Evaporation.	
Greatest 1839	84·40 in.	Greatest 1826.....	26·44 in.
Average 14 years	27·15	Average 14 years ...	22·67
Least 1840	21·88	Least 1839	20·52

At this meeting it was resolved that the Society's standard barometer be sold, in order to lessen the financial liabilities of the Society.

1841, December 14. Mr. J. W. G. Gutch in the Chair. One member elected. Mr. J. Harrison, of Downham, Norfolk, submitted drawings of two new forms of anemometer. In the first the pressure plate is fixed to the end of a horizontal rod, at the other end of which is a point. This rod is hung between two crutches by means of four vertical rods, so that it can swing freely, but is always kept horizontal. As it is forced backward by the pressure of the wind it gradually rises, and the pointed end of the rod travels over a scale (on which the pressures and velocities are engraved), and the curvature of which scale corresponds with that described by the end of the horizontal rod. The whole apparatus is kept facing the wind by a vane below the pressure plate.

In the second design the rod at the back of the pressure plate, which always remains horizontal, is hinged to another rod, pivoted a few inches above the hinge, which rod, in time of calm, hangs vertically with a weight attached to its lower end. Any wind pressing upon the plate pushes this weighted rod away from the perpendicular, and the force exerted is shown by the amount of deflection. The weighted free end of the rod travels over a graduated arc, which runs from the vertical vane rod to a horizontal rod starting from its top, and the arc, being provided with catches, and the rod with a spring to hold into them, the rod always shows the greatest pressure which has occurred since the previous observation.

Several other papers were read, but I can notice only two—one by Mr. H. W. Bailey, "On the Epidemic of Scarlatina," which the author considered to be connected with the recent vicissitudes of the weather. The other paper was by Dr. Govan, of St. Andrew's, who called attention to the regularity with which epidemic cholera travelled from the East, and with which its intensity decreased as it passed over Europe.

* *Quarterly Journal*, page 28

At this meeting it was ordered that a second circular be issued, announcing the appearance of the *Quarterly Journal* on January 1, 1842.

1842, January 11. Mr. J. W. G. Gutch in the Chair. One member elected. Lieut. Morrison read a paper "On the oscillations of the Barometer, and of diminished pressure previous to periods of High Winds,"* in which he objects to all previously offered explanations, and contends that the diminished pressure is due to a change in the electrical state of the particles of air, leading to increased repulsion and so [?] to diminished pressure.

1842, February 8. Dr. Lee, F.R.S., in the Chair. One member elected. Mr. J. W. G. Gutch read a paper "On the Prognostics of the Weather derivable from the study of the Animal, Vegetable and Mineral Kingdoms."† This was a very good paper; it occupies nearly 20 pages of the *Quarterly Journal*, and is partly analogous to Claridge's "*Shepherd of Banbury's Rules for judging the Weather*," and almost trenches on the territory of our phenological staff. As, however, it is printed *in extenso*, I need quote only one paragraph, itself a quotation from Captain Basil Hall. I reprint this as an early claim for sea-coast barometers, if not for storm signals:—

"For more than 24 hours before the great gales of November 1840 my barometer at Portsmouth foretold so unequivocally the approach of a furious storm, that I have good reason for believing, if this fact had been publicly announced, many boats—and, perhaps, many ships—and their crews would have been saved from the destruction into which they ran themselves from sheer ignorance of the impending bad weather, of which there were no other indications."

SESSION 1842—43.

1842, March 8. Anniversary Meeting. The Right Hon. Lord Robert Grosvenor, President, in the Chair. This was one of the best attended meetings during the year; nineteen names appear in the attendance book, and six others ought to have been, only those members forgot to sign. Among the names are several still well known; two still among our Fellows, Lord Ebury and Mr. Casella, one not long gone from us, Dr. Lee, and two who, though not with us, retain some of their interest in our pursuits: I refer to Mr. J. Bailey Denton, and to Mr. P. L. Simmonds. Considering that that meeting was held forty years ago, it is somewhat remarkable that so many should still be spared. And there may very possibly be others whom I do not know.

The business was, of course, the reading of the Annual Report. This dwelt with great satisfaction upon the success of the *Quarterly Journal*; stated that a premium of £10 10s. had been offered for the best essay on Barometric Pressure; that meetings would in future be held monthly throughout the year; that the Society contemplated taking rooms in Old Bond Street of a better character and at a rather higher rent than those then occupied in Bedford Street, feeling itself justified in so doing by the increase in the number of members. The liabilities of the Society were stated to have been much reduced, and the List of Members was said to have been cleared of all non-paying members, so that it is a "*bonâ-fide* list, and not made up of gentlemen who put their names down to a Society's list, but refuse to aid and support it by the subscription to its funds, and which it is in all honesty entitled to expect."

After the Report two or three papers were read. One of these was by Mr. P. L. Simmonds, "On the Fall of Rain on different parts of the

* *Quarterly Journal*, p. 67.
† *Quarterly Journal*, pp. 5-13 and 74-85.

Surface of the Earth." This paper dealt with the fall at about 20 British, and at many Foreign and Colonial Stations, *e.g.* Grenada, St. Vincent, Port Macquarie, Port Jackson, Adelaide, and Nassau, New Providence. This paper was ordered to be printed in No. 3 of the *Quarterly Journal*, but it did not appear, and is not among the rescued MSS. of the Society.

1842, April 12.

1842, May 10.

1842, June 14. Dr. Lee, F.R.S., in the Chair. Two papers read: one "On the Weather as a Science," by Mr. J. Smith, of Glasgow. This was chiefly a strong advocacy of the Primary Cycle of the Weather, said to have been discovered by Lieut. Mackenzie, of Perth. The paper is printed in the *Quarterly Journal*. "On Atmospheric Electricity," by Mr. W. H. White, in which the author tried to show parallelism between the results of Mr. Weekes's important electrical experiments at Sandwich and certain planetary aspects.

1842, July 12. Mr. G. Leach in the Chair. The following papers were read:—"On the Temperature of the Atmosphere in England," by Mr. O. Whistlecraft,* which, in spite of its ambitious title, is hardly worth noticing, and "On the Solar Eclipse of July 8th, 1842, as observed at Shepscombe, Gloucestershire," by Lieut. Morrison.† This was a partial eclipse (about eight digits I think), and the lieutenant found the temperature of the air depressed at the time of maximum obscuration. Lieut. Morrison assumes a far greater effect than after plotting his observations I can admit; he makes the depression of temperature during the eclipse, 8°, but I think that 3° is nearer the truth.

1842, August 9. Mr. J. Reynolds in the Chair. The following papers were read:—"On Severe Winters," by Duncan Forbes, of Culloden. This is a very interesting catalogue of severe frosts from A.D. 763 to 1824; as it is printed *in extenso* in the *Quarterly Journal*, p. 180, I need only refer to it to correct a double misprint. Mr. Forbes says that his earlier records are abridged from a translation of a bulky German work by Pilgrino, published at Vienna in 1783. Pilgrino should be Pilgram, and 1783 should be 1788. I have the original, but not the translation, and I doubt whether any translation has been published. Pilgram's is a wonderful book, contains, for instance, a list of auroræ from A.D 394 to A.D. 1784, and much other interesting matter. Its full title is "Pilgram A. *Untersuchungen ueber das Wahrscheinliche der Welterkunde durch vieljährige Beobachtungen.* 2 Bande 4to. *Wien* 1788."

But I must return to the papers read at the meeting on August 9, 1842. Major Stack read a paper "On the Dark Days of North America." This was a personal record of an intense darkness at mid-day in summer in Montreal. The air was perfectly dry, and the phenomenon presented very similar characteristics over an area of some thousand square miles. The author discussed the suggestion that the obscuration was due to burning prairies, and gave his reasons for doubting that explanation: one reason being the blackness of the obscuration, prairie smoke being white. It seems to me, however, that a mass of prairie smoke, though only whitish or grayish in itself, would sufficiently obscure the sunlight to produce the effects described. However, Major Stack's paper is printed *in extenso*, and those who feel so inclined will find it in the *Quarterly Journal*, p. 188.

Mr. J. T. Goddard (the inventor of the Cloud Mirror) gave a "Description of an instrument for rendering apparent the momentary variation in the atmospherical pressure." This paper having been printed *in extenso*,‡ I need

* *Quarterly Journal*, p. 175.
† *Quarterly Journal*, p. 214.
‡ *Quarterly Journal*, p. 192.

say only that the instrument is virtually a very small diving bell with a tube out of the top of it, which becomes more or less immersed in a jar of water with the slightest variation of atmospheric pressure.

1842, September 13. Mr. J. Reynolds in the Chair. The only paper read of which I can find any record is one by Mr. Eadie, "On the Properties of Hydrogen." This is a dreadful paper, containing so many fallacies and marvellous stories that I decline to spend any time over it.

1842, October 11. Mr. J. W. G. Gutch in the Chair. The principal papers were "On a Violent Hurricane at Calcutta, June 6, 1842," by Mr. Piddington, and "On the Meteorology of Australia," by Mr. P. L. Simmonds.

1842, November 8. Mr. J. W. G. Gutch in the Chair. "On the results of experiments on the situation, size and shape of rain gauges," by Mr. J. Atkinson. This was one of the best papers sent in to the Society. Mr. Atkinson, after considering the results obtained by Prof. Phillips at York as to the influence of elevation on the amount of rain collected, and also Dr. Robinson's advocacy of a spherical rain gauge, decided upon trying some experiments himself. The following is a brief summary of the results. The observations are printed *in extenso* in the *Quarterly Journal*, pages 243-248, and the subsequent 12 months on pages 305-307.

Abstract of Results of Experimental Rain Gauges at Harraby, Carlisle.

Pattern of Gauge.	Horizontal Funnel.	Horizontal Funnel.	Horizontal Funnel.	Funnel inclined 45°.	Sphere.	Horizontal Funnel.	Sphere.	Horizontal Funnel.	Sphere.
Diameter	In. 12	In. 12	In. 12	In. 12	In. 12	In. 18	In. 12	In. 12	In. 12
Height above Ground	Ft. 0	Ft. 3	Ft. 6	Ft. 6	Ft. 6	Ft. 6	Ft. 0	Ft. 12	Ft. 12
November 1840 to October 1841..	39·222	37·406	35·541	37·428	34·981	33·036	..	..	..
Year 1842	23·662	..	21·825	..	22·001	..	23·357	23·100	27·217

1842, December 13. Dr. Lee, F.R.S., in the Chair. Papers read: "On the Westerly and Trade Winds," by Rev. J. Toplis; "On an Hourly Self-registering Thermometer," by Mr. M'Farlane; and "On the extraordinary range of the Barometer and Rainfall of November 1842," by Mr. W. H. White. In the table accompanying this paper the greatest amount of rain is given as 14·85 ins. in Carmarthenshire, and the least as 2·30 ins. at Comrie, in Perthshire.

SESSION 1843—44.

1843, January 10.

1843, February 14. Mr. J. W. G. Gutch in the Chair. Papers read: Mr. W. Lassell, "On the Weather near Liverpool in 1842;" Mr. P. M'Farlane, "On an hourly Self-registering Barometer;" an undesirable plan, fully illustrated in the *Quarterly Journal*, p. 286; Mr. D. Forbes, "On a remarkable Electrical Phenomenon seen December 9, 1842, at Comrie and other places."

1843, March 14. Lord Robert Grosvenor in the Chair. The Annual

Report was read. The Society consisted of 65 Members, 59 Foreign Associates, and 10 Honorary Members. One or two papers were read, and then Mr. Gutch delivered an eloquent, and, in many respects, able address upon some of the leading results of atmospheric action and on lines of research which ought to be followed up. The paper is printed *in extenso* in the *Quarterly Journal*, pages 375-385, and need, therefore, not be reprinted.

1843, April 11. Mr. G. Leach in the Chair. Three members elected. Mr. M'Farlane read three papers; one on some improvements in the self-registering barometer, which he had described in February; another on a self-recording anemometer. The special feature of this was that the vane carried a horizontal tube (like one pattern of modern ventilating cowl) with an enlarged mouth turned towards the wind. Inside this tube there was a small oblique fan (like a ship's screw), which, of course, was compelled to rotate by the rush of the air through the tube. This gave the velocity, and the direction was given directly by the vane. Mr. M'Farlane's third paper was "On an Hourly Self-recording Rain-gauge." This, though probably the author did not know it, any more than Mr. Stutter did, who hit upon the same principle, is a very old plan. In 1789 C. Hermann published a little 8vo, at Freyburg, entitled '*Mechanischer verbesserter Wind, Regen und Trockenheits Beobachter*,' and therein both Messrs. M'Farlane and Stutter will find themselves anticipated. Mr. Lawson, F.R.S., without, as far as I can trace, at all referring to the decision respecting the termination of the meteorological day adopted on the 8th of June, 1841, brought up the subject again, feeling perhaps (as well he might) that the said decision was very injudicious.

1843, May 9. Mr. G. Leach in the Chair. Three members elected. Papers were read by Mr. M'Farlane respecting his self-registering barometer, and enclosing a letter of approval of it by Mr. D. Milne; by Mr. J. Ruskin, "On a double lunar rainbow, with two paraselenæ, as seen at Camberwell, March 18, 1843;" and by Lieut. Morrison, "On Solar, Stellar and Cometary Light, with an attempt to explain their influence on the Atmosphere." This paper was followed by a thoroughly Astro-Meteorological one, by Mr. W. H. White, and whether this killed the Society or not, I cannot say, but curiously enough, this is the last meeting of which I have any record.

THE BRITISH METEOROLOGICAL SOCIETY.

Few better proofs of the need for some such statement as I have laid before you could be produced than the following paragraph, which is frequently assumed to give the true history of the formation of the present Society. It will be found on page 305 of Admiral Smyth's '*Cycle of Celestial Objects Continued*,' 4to, 1860.

"The actual Science of Meteorology, however, has languished for want of the spirited and pointed aid which is given to other branches of physical inquiry by associated bodies of votaries. Many valuable registers were kept, of which the mere numerical mean values were known, while others were entirely lost from want of being classified and reduced."

"It, therefore, struck a few amateurs that, in order to secure the advantages of arrangement, publication, and well-concerted combination, an express association ought to be formed; and accordingly, on the 4th [3rd, G. J. S.] of April, 1850, a meeting of some friends of the science was convened by Dr. Lee, at Hartwell, where, in the library, they agreed upon a general system of observation, uniformity of registry, systematic communication, and other measures for insuring precision to the advancement of the

aërostatical branch of physics. At this decisive meeting the gentlemen present elected Samuel Charles Whitbread, Esq., of Cardington, near Bedford, as their President, appointed an efficient Council to carry out regulations, and thus established the present British Meteorological Society."

It may be well to record those present upon that occasion: they were—

Drew, John, F.R.A.S.	Lee, J., LL.D., F.R.S.	Reade, Rev. J. B., F.R.S.
Fasel, V., F.R.A.S.	Lowe, E. J., F.R.A.S.	Rutter, W., F.R.A.S.
Glaisher, J., F.R.S.	Lowndes, Rev. C., F.R.A.S.	Whitbread, S.C., F.R.A.S.
King, Rev. S., F.R.A.S.		

It is strange indeed that Dr. Lee, at whose house this meeting was held, who had himself presided at many meetings of the old Society, who was its treasurer for many years, and at whose expense this book of Admiral Smyth's was printed—it is, I say, strange that Dr. Lee should have allowed the Admiral to completely ignore all the work of the previous Society, and even its existence.

There is another fact which renders it equally puzzling to understand the silence of Admiral Smyth, and it is, that more than a quarter of the Council of the new Society had held similar office in the old one, for in the scarce "*Address of the British Meteorological Society explanatory of their* (sic) *objects*," the first Council was said to contain Lord Robert Grosvenor, Luke Howard, Dr. Lee, John Drew and George Leach, all office bearers of the old Society.

The fact seems to have been that there was a desire to forget the astro-meteorological tendencies of the old Society, and, with a new President, a partially new Council, and (most important of all) a new Secretary, Mr. James Glaisher, F.R.S., to start entirely afresh.

The opening address issued by the British Meteorological Society on December 2nd, 1850, adopted precisely the same course as Admiral Smyth, and it appears strange that the five members of the Council of the Meteorological Society of London should have consented to the Address of the new Society beginning with the following paragraphs:—

"The science of Meteorology has remained up to the present time without that assistance which is given to many other branches of physical inquiry by associated bodies. Its successful study, however, requires the combined efforts of numerous observers, steadily following a well-concerted plan, employing the same class of instruments, and reducing their results in the same form.

"In order to secure these advantages, it has long been a matter of consideration whether the benefit of association, already found to be so important in advancing other physical sciences, may not be made available to encourage and support that of Meteorology. With this intention a Society has been formed, to be called the 'British Meteorological Society.'"

But though the Meteorological Society of London had done nothing since 1844 except pay off its debts, the formation of the British Meteorological Society aroused both the Secretary, Mr. White, and the Treasurer, Mr. Gutch, of the old Society. The former wrote, saying that at a meeting held on August 14, 1850, the old Society was formally dissolved, a resolution was passed that the books and MSS. in the Secretary's hands be presented to the British Meteorological Society, and the members of the old Society be recommended to join the new one. There is no record of this letter having been answered, and moreover, a rather haughty resolution was passed insisting that the members of the old Society could only be admitted after due recommendation and ballot. The result of this was that the British Meteorological

Society did not get the MSS. But, happily, they were not destroyed; I purchased them myself some years since, and am glad now to offer them to the Society, in the Library of which—admitting their imperfections—I think they ought to be.

The Treasurer of the old Society had also a number of books and MSS., and although in the *Address* the new Society ignored the old one, yet, in their first annual *Report*, the Council say:—

"It having been represented to the Council that the papers, &c. which had been collected by the late London Meteorological Society, and all the papers which had been received up to the present time, were in the hands of J. W. Gutch, Esq., and that these papers would be delivered up to the Society by Mr. Gutch on certain conditions, and with the consent of its late President, Lord Robert Grosvenor, the Council agreed to the conditions, and the books, papers, &c., are now in the Library of the Society."

As already mentioned, the British Meteorological Society was founded on April 3, 1850, but no general meeting of the members was held until 25th March, 1851. Meanwhile several important decisions and steps had been taken by the Council, which do not appear either to have been reported to or sanctioned by any general meeting.

About 150 members had been admitted.

The Secretary (Mr. Glaisher) had been requested to provide himself, at the cost of the Society, with sufficient extra copies of all papers printed by him to send one to each member.

With Mr. Glaisher's consent, it had been resolved to print 500 copies in 8vo. of his Diurnal Range Tables.

A blank form for observations had been approved, and 2,000 copies printed.

It had been resolved that all observations collected on these forms be given to Mr. Glaisher and considered as his property.

Mr. Hugh Gordon had been appointed to assist Mr. Glaisher at the salary of £52 per annum.

Three hundred extra copies of Mr. Glaisher's paper on thermometer observations, at Somerset House, had been ordered to be printed at the cost and for the use of the Society.

One hundred and fifty copies of his 'Essay on Clouds' had been presented by Mr. Luke Howard and distributed to the members.

It had been resolved that all Life Compositions be funded.

I have not been able to find minutes of all the ordinary meetings, even after they began to be held regularly; but a general, if not very, detailed, account of the Society's work is given in the Annual Reports, which our Society has published without interruption for thirty years.

Since 1860 we have published, not merely the Annual Reports, but five volumes of 'Proceedings' and six similar volumes with the title 'Quarterly Journal of the Meteorological Society.' It will, therefore, be necessary for me only to epitomise the history of the period 1851 to 1860.

The first ordinary meeting of the Society was held at 13 Moorgate Street, March 25, 1851, Mr. S. C. Whitbread, President, in the Chair. 18 members were present. The President announced the formation of the Society. The Secretary (Mr. Glaisher) described its objects. The Institutes were read through and adopted. Mr. Glaisher read a paper "On the heavy rain of March 15, 1851," when 1·72 in. fell at Lewisham between 1 a.m. and 4 p.m.

The first anniversary meeting was held at the same place on May 27, 1851, when the annual report was adopted and ordered to be printed. Mr. T. Hopkins read a paper "On the Daily Variation of the reading of the Barometer," and the Rev. J. B. Reade exhibited part of a tree struck by lightning.

1851, August 26. Ordinary Meeting. Papers read: Dr. Hoskins, "On the Climate of Guernsey;" Mr. G. Smith, "Temperature Changes during the Eclipse;" and Dr. Buist, "On the fall of Rain at Bombay, 1817 to 1850." It is greatly to be regretted that no details of these papers have been preserved, they are not even mentioned in the Annual Report. Yet everything that Dr. Buist wrote was good.

In 1852 the Society criticised severely, and I do not say unjustly, the Instructions for Meteorological Observations drawn up by Captain (afterwards Major-General Sir Henry) James for the Ordnance Department, and this, I presume, led to the Society not being asked to assist at the Brussels Conference, held in the autumn of that year. As these criticisms are printed *in extenso* in the Second Report, I need not dwell upon them.

On January 6, 1852, the Society met for the first time at the rooms of the Chemical Society, in Cavendish Square, having agreed to rent the meeting room at £20 per annum—a practice which continued until October 27th, 1857.

On January 25, 1853, a paper was read of which only the title has been preserved; but it may be well to print the title as a guide to those of our Fellows who are now studying the subject—"On the amount of Evaporation from two Surfaces of Water, each with an area of 9 square feet, the one under cover, the other open, as well as the fall of rain in 1852 at Woolwich," by Capt. (now Major-General) Henry Clerk, R.A., F.R.S.

From February till October 1853, Mr. Glaisher was too ill to attend the meetings, scarcely any minutes are preserved, and I do not know whether all the regular meetings were held or not.

During 1855 two very valuable papers were read at Ordinary Meetings of the Society, and both are printed *in extenso* in the Fifth Annual Report—one by Dr. G. Buist, "On the means of determining the actual amount of Evaporation from the Earth's surface," and the other by Mr. Glaisher, "On the severity of the past Winter, and on Snow Crystals observed during it." This paper was accompanied by 151 drawings by Mrs. Glaisher, and the Society most wisely resolved upon engraving the whole of them. The cost of engraving was only £33, of printing in colours £23, total £56, and nearly half of this was presented by about a dozen members, so that the finest set of engravings of snow crystals ever issued was published by the Society at a cost to itself of scarcely £30. Resolved that the blocks be Mr. Glaisher's property.

On October 30, 1855, it was announced that Mr. H. Lawson, F.R.S., and Vice-President of the Brit. Met. Soc., had died, and that he had left to the Society the sum of £200 duty free. I think it is equally a matter for surprise, and for regret, that this is the only legacy which the Society has received.

On January 27, 1857, Mr. Glaisher read his important and elaborate paper "On the mean temperature of every day from 1814 to 1856"; it was ordered to be printed as speedily as possible, and it will be found in the Seventh Annual Report.

After June 1857 it was found impracticable to continue to meet at Cavendish Square; the celebrated Engineer, Robert Stephenson, was then our President; he obtained for us permission to hold our meetings at the Institution of Civil Engineers without any payment whatever. And though we fully recognise that the continuance of this favour rests and has rested through the long period of 14 years with successive Presidents and Councils of that body—a favour which as far as I am aware has no parallel—yet we must always associate the fact with the honoured name of Robert Stephenson.

Up to 1858 absolutely nothing had been done towards forming a Library:

it was reported that "some of the books were at Doctors' Commons, some at Cavendish Square, and others elsewhere," and it was sagely resolved that the books be collected, a catalogue prepared, and £10 allowed for binding; at a subsequent meeting it was reported that Mr. Glaisher had sent two parcels of books from Blackheath, that a cab full had been brought from Cavendish Square, and three bags and three boxes full had been fetched from Doctors' Commons. The catalogue made little progress until Mr. Eaton became Librarian, and only appeared in 1862. It was a pamphlet of 11 pages, and containing about 200 titles. A remarkable contrast to the catalogue issued in 1876, which extends to 80 pages, and contains 1,214 entries.

I find with regret, but considering the history of the earlier Society, and the neglect of the Library during the first 10 years of our existence, I am not surprised, that only a small portion of the books presented to the old Society are now to be found, and not by any means all of those sent to the present Society. Whatever, however, may have been the failings of this Society in this respect in the past, they have been completely atoned for by the wise and liberal action of the Council for several years, which not only induced them to print a catalogue which has been highly spoken of throughout Europe, but has also gradually rendered our Library one of which the Society is entitled to be proud.

In the Report of the Meteorological Department of the Board of Trade for the year 1858 Admiral FitzRoy stated that he had supplied "ten substantial barometers, durable and easy to observe, as experimental loans at certain stations," and said further that "such assistance is urgently needed on the East Coast of England." Subsequently, in the Autumn of 1859, the Duke of Northumberland wrote to our then President (Mr. Sopwith, F.R.S.) suggesting that accurate barometers, plain, strong, easily read and not liable to injury by movement, would be useful if placed at the fishing villages and harbours on the Northumbrian coast; and he further offered to pay £100, or half the cost, if the Meteorological Society would take the management of the observations. The Council supported the proposal. Mr. Glaisher instructed Messrs. Negretti and Zambra to prepare 14 barometers, which were compared with the Greenwich Standard, conveyed to Northumberland, and erected at 14 fishing villages by Mr. Glaisher himself.

There is no doubt that this vigorous action led not merely to the saving of many lives upon that wild coast, but also to increased activity on the part of the Life Boat Institution.

In connection with this subject I ought also to mention an able paper by Mr. Sopwith on "Barometer Indicators," read at the meeting on January 16, 1861, and printed *in extenso* in the Eleventh Annual Report.

There are a few facts in our history which have occurred since 1861 which, although fully detailed in our publications ought not to be passed in entire silence.

The first which I select is the resolution adopted October 16, 1861, that the Proceedings of the Society be printed and circulated amongst the members. Previous to this date only an Annual Report had been issued, but on and after November, 1861, the Proceedings have been regularly published. Up to this time all printing had been supervised by Mr. Glaisher alone, but as the issue of the Proceedings greatly increased the work, Mr. C. V. Walker, F.R.S., undertook almost, if not quite, all the labour of editing the Proceedings; after a few years Mr. Walker was, through the pressure of other engagements, obliged to transfer the duty to Mr. Glaisher, who carried it on until 1874, from which time it has been discharged by a special committee of the Council.

Another important fact was the obtaining of a Royal Charter. This was mentioned as early as October, 1863; the Council at their meeting March 16,

1864, resolved to advise the members to authorise them to apply for one. At the general meeting on June 15, 1864, the members resolved "That the Council be requested to take the necessary steps to obtain a Royal Charter of Incorporation," and it was obtained and signed by command on January 27, 1866.

The necessary fees, as well as the providing of a corporate seal and other incidental expenses, were met by a subscription, but the cost was reduced to a minimum by the extremely handsome behaviour of one of our Fellows, and one whom we are glad still to have on the Council—Mr. Brewin, who transacted the whole of the legal arrangements gratuitously.

This Charter confirmed the position which the Society had won by steady work; it ceased to be the BRITISH *Meteorological Society* and became THE Meteorological Society, and the members were by a stroke of the official pen all turned into Fellows.

THE METEOROLOGICAL SOCIETY.

The next fact has done more towards rendering us an efficient working body than even the Charter itself. On April 4, 1872, the Council resolved upon taking a room for an office and for the protection of the Library, and obtained as their Assistant Secretary one of their Fellows, Mr. W. Marriott, whose previous training at the Royal Observatory had admirably fitted him for the office which he has now held for 10 years. But the work had become far too great for Mr. Marriott to deal with single handed, and hence we now have additional space, and three computers to work under him. I wish that the three could be six, for there is ample work for that number.

Twelve months afterwards Mr. Glaisher, who had held the office of Secretary, except during the two years 1867-8, during which he was President, from the foundation of the Society, resigned that office, but accepted a seat upon the Council, which I have always considered it a pity that he did not occupy, so as to have aided in its prime that Society which he developed in its early stages and guided through its youth.

The subsequent eight years have been characterised by great progress. I must dismiss several subjects without mention, and treat the others with a brevity which they by no means deserve.

We have organised perhaps the most rigorously uniform, and most nearly perfect set of Second Order Stations in the world. Their total number is not very large (24), but they are well distributed, they are most carefully and systematically inspected, and plans have been published showing exactly where the instruments are placed. I may be allowed here to say, that I think that these plans are not only of great use as records of the conditions under which the observations are made, but also useful to new observers as guides to the positions which are permitted by the Society's Inspector of Stations. I have seen results published as air temperatures obtained from thermometers inside a hen house, I have seen a rain gauge under the eaves of a cottage, and another under a tree. But these were in far bygone years, and with the Society's system of inspection, the Fellows and the Public may implicitly rely upon the values we publish. As to the checking of the returns, it is as rigorous as the inspection.

We have also a larger and rapidly growing, but still far too small series of stations (50) which we call "Climatological Stations," at which the observations are less onerous than those at the "Second Order Stations," but at which they are required to be equally accurate. Absolute identity of instruments, of mounting them, and of recording the observations, is insisted upon, and hence for the first time we are beginning to collect absolutely unimpeachable data respecting the local features of the climate of the British Isles.

In 1874 a Committee of the Council, while preparing a blank form for the

entry of the Meteorological Observations at the Second Order Stations, considered the question of the registration of Natural Periodical Phenomena, and reported to the Council that "Natural Periodical Phenomena, especially as bearing upon the influence of the Seasons on the state of Agriculture, be entered on a separate form." They, therefore, suggested that application be made to various societies to nominate delegates to serve on a joint committee for the purpose of drafting complete instructions and organising in an efficient manner this branch of observation. The Council agreed to the proposal; application was made to the Societies, and the following delegates were nominated:—

Royal Agricultural	W. Carruthers, F.R.S.
	C. Whitehead, F.L.S.
Royal Horticultural	Prof. W. T. Thiselton Dyer, F.L.S.
	R. McLachlan, F.L.S.
Royal Botanic	Prof. R. Bentley.
	G. J. Symons.
	W. Sowerby, F.L.S.
Royal Dublin	Dr. G. J. Allman, F.R.S.
Marlborough College Nat. Hist.	Rev. T. A. Preston, M.A.
Meteorological	Dr. R. J. Mann, F.R.A.S.
	Rev. C. H. Griffith.
	H. S. Eaton, M.A.
	R. H. Scott, F.R.S.

Several of the above names would, individually, be ample guarantee for the work being well done; but in addition to the above, the Committee had the valuable assistance of Prof. A. Newton, F.R.S., who compiled the List of Birds. The result of the labours of the Committee was published in 1875, under the title of "*Instructions for the Observation of Phenological Phenomena*," and from that time onwards a gradually improving staff of observers of this class of objects has been growing up in connection with the Society. The successful development of this branch of our work is mainly due to the energy and industry of one of our Fellows, the Rev. T. A. Preston.

A similar course was adopted with reference to the subject of Lightning Conductors. Knowing that there was a great need for plain and accurate instructions respecting the erection of Lightning Conductors, the Council invited the assistance of several Societies, and obtained that of the following:—

Royal Institute of British Architects	J. Whichcord, F.S.A., Vice-President.
	Prof. Lewis, F.S.A.
Society of Telegraph Engineers	J. Latimer Clark, M.I.C.E., Past President.
	W. H. Preece, M.I.C.E., Vice-President.
Physical Society	Prof. W. G. Adams, F.R.S., President.
	Prof. G. Carey Foster, F.R.S., Past President.
Meteorological Society.....	C. Brooke, F.R.S., Past President.
	E. E. Dymond.
	G. J. Symons, F.R.S., Secretary.

The Conference has been steadily at work since November 1878, and has not yet issued its Report. The Conference has lost by death Mr. C. Brooke, who was President of this Society 1865-66, and has obtained the assistance of Prof. W. E. Ayrton and of Prof. D. E. Hughes, F.R.S.

There is also a joint Committee of representatives of the Meteorological Council and of our Society, considering the question propounded by the

Austrian Government relative to the alleged recent diminution in the Water Supply over a considerable part of Europe, which is collecting data respecting rainfall and the measurements of wells and rivers.

I have only time to remind you of one more fact—the series of free public Lectures on Meteorology given in the winter of 1878, at the suggestion and by the liberality of my predecessor, Mr. C. Greaves, C.E.

In conclusion, I invite your attention to the annexed diagram (p. 96): it does not claim to be precisely accurate, but is sufficiently near the truth for my purpose.

The uppermost line represents the total numerical strength of the Society in each year from the foundation of the Brit. Met. Soc.; it shows a steady rise from 150 to 350, then (about 1870) a slight check, owing to the removal from the list of several Fellows whose subscriptions were in arrear, and from 1874 onwards a rapid rise, until now we are just passing the line of 500. But, considering the wide-spread interest taken in meteorology, considering its bearing on health, both directly in the choice of health resorts, and indirectly as affecting various sanitary matters; considering its bearing on engineering as regards drainage, water supply, and the force of the wind upon such structures as the Tay Bridge; and if last, certainly not least, considering its influence on agriculture, on shipping interests and on the personal comfort of almost everybody,—looking, I say, at the wide-spread and divers interests related to meteorology, I hope to see the day when some future President will announce the election of the thousandth Fellow.

There are two other curves to describe. The centre one shows the funded property of the Society, which has gradually risen until it now stands at nearly £1,200. It will be noticed that this line does not rise so rapidly as that representing the number of Fellows. It is, however, more than the whole sum paid as Life Composition by all the compounders on the register. And, personally, I think it far better to work the Society vigorously and liberally than to starve it in order to collect large funded property.

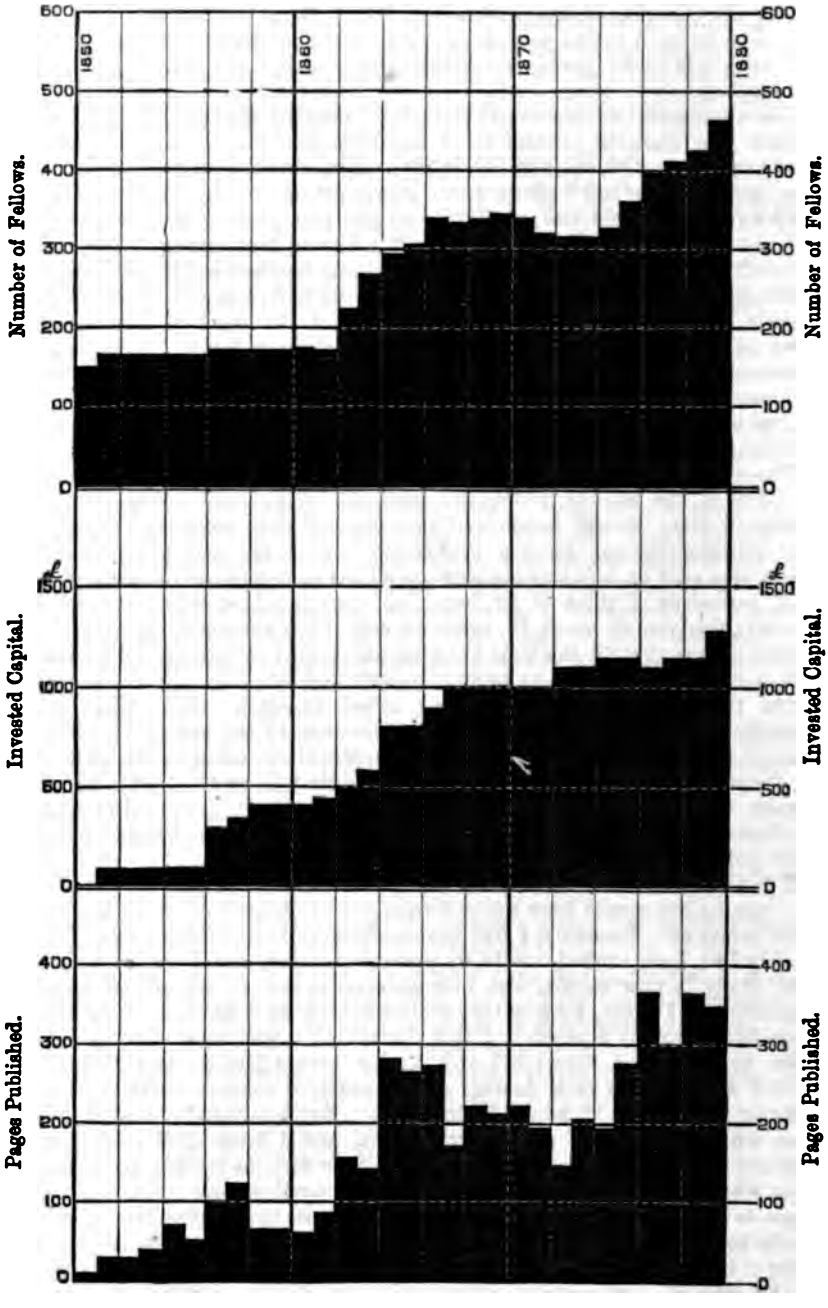
The bottom curve is the least to be trusted of the three, but it is intended to give a rough idea of the amount of matter published by the Society. It shows the number of printed pages issued in each year. Of course, quantity is no test of quality, but examination of the volumes will show that, in many respects, the quality has increased as much as the quantity.

One word in conclusion to those, and doubtless there are some such, who wonder why I should have spent so much time in hunting up and rectifying the history of Societies and Individuals long passed away, and in epitomising some parts of our own recent work.

I have several answers. In the first place, we must be dull indeed if we can gain no experience from the successes and the failures of those who have gone before us. Secondly, I was anxious to show how well and honestly the Society has been worked up to its present position, and I wished to show how firmly it now stands, and how widespread are its sympathies and its operations. Thirdly, I knew that such a history as I have given could not come before you as a paper, and that therefore if it were ever to be written it must be done by a President; and having been a Member and Fellow for within a few weeks of a quarter of a century, it seemed likely to be less difficult to me than it might be to others. But lastly and chiefly, I know that we already have many new Fellows, and I trust shall soon largely increase their number; and that they cannot procure the reports and volumes from which I have compiled this sketch mainly for their use. But it will also serve as a sort of index to our publications, and in that respect may prove as useful to those with whom it has long been my privilege to work, as in other ways it may be to those who have recently joined us, or who may join us in the future.

These then are some of my reasons for occupying your time with the history of English Meteorological Societies from 1823 to 1880.

CURVES ILLUSTRATIVE OF THE HISTORY OF THE METEOROLOGICAL SOCIETY.



Publications (chronologically arranged) of the Meteorological Society of London.

Date.	Title.	Where Copy is preserved.	Size.	Pages.
1832	Circular as to state of Society	Meteorological Society	4to.	1
1837	Laws of the Meteorological Society	No copy known to exist.....	..	..
1838	Laws and Regulations of the Meteorological Society	Meteorological Society	12mo.	18
1839	Transactions of the Meteorological Society, Vol. I.	Meteorological Society	Large 8vo.	262
1841	Proceedings of the Meteorological Society. Sessions 1838-39 and 1839-40	British Museum and perhaps Lit. Inst. Newcastle-onTyne	8vo.	28
1842	Proceedings of the Meteorological Society. Session 1840-41, and Nov. 1841 to March 1842.....	Mr. Symons's Library	8vo.	30
1842 and 1843	The Quarterly Journal of Meteorology and Physical Science. (Published under the immediate sanction and direction of the Meteorological Society of Great Britain. (*sic*).)	Meteorological Society	8vo.	440
1843	Circular as to state of Society, January, 1843	Meteorological Society	4to.	3

Publications of the British Meteorological Society, and of The Meteorological Society.

(All except those marked * are in the Library of the Meteorological Society.)

Date.	Title.	Size.	Pages.
1850	Address of the British Meteorological Society	8vo.	4
1850	List of Members of the British Meteorological Society*	8vo.	?
1850	The Institutes of the British Meteorological Society	8vo.	16
1851	Ditto ditto	8vo.	16
1851	List of Members of the British Meteorological Society*	8vo.	?
1851	Report of the Council of the British Meteorological Society, read at the 1st Annual Meeting	8vo.	4
1852	Ditto, 2nd Annual Meeting	8vo.	12
1853	Ditto, 3rd Annual Meeting	8vo.	14
1854	Ditto, 4th Annual Meeting	8vo.	34
1855	Ditto, 5th Annual Meeting (with 36 pages of engravings)	8vo.	32
1856	List of Members of the British Meteorological Society.....	8vo.	8
1856	Report of the Council of the British Meteorological Society, read at the 6th Annual Meeting (with 1 plate)	8vo.	48
1857	Ditto, 7th Annual Meeting (with 12 sheets of tables and 1 plate)	8vo.	64
1858	Ditto, 8th Annual Meeting	8vo.	128
1859	On the Meteorological and Physical Effects of the Solar Eclipse of March 15, 1858 (4 plates)	8vo.	46
1860	Ninth and Tenth Reports of the Council of the British Meteorological Society (2 plates)	8vo.	86
1861	Report of the Council of the British Meteorological Society for the 11th Annual Meeting (1 Plate)	8vo.	62
1861 to 1871	Five Volumes of Proceedings of the British Meteorological Society	8vo.	2210

PUBLICATIONS OF THE BRITISH METEOROLOGICAL SOCIETY, AND OF THE METEOROLOGICAL SOCIETY—*Continued.*

Date.	Title.	Size.	Pages.
1862	List of Members of the British Meteorological Society	8vo.	8
1862	Catalogue of Library	8vo.	12
1863	The Institutes of the British Meteorological Society	8vo.	18
1863	Supplementary Catalogue of Books	8vo.	2
1864	List of Members	8vo.	11
1864	Catalogue of Library	8vo.	14
1866	Charter and Bye-Laws	8vo.	21
1867	List of Members (*sic*) of the Meteorological Society	8vo.	11
1869	Ditto	8vo.	12
1872-3	Quarterly Journal of the Meteorological Society, Vol. I.	8vo.	276
1873	List of Fellows	8vo.	11
1874	Charter and Bye-Laws	8vo.	17
1874-5	Quarterly Journal, Vol. II.	8vo.	468
1875	Instructions for the Observation of Phenological Phenomena	8vo.	15
1876	Catalogue of Library	8vo.	78
1876	List of Fellows	8vo.	16
1876-7	Quarterly Journal, Vol. III.	8vo.	601
1878	Quarterly Journal, Vol. IV.	8vo.	309
1878	List of Fellows	8vo.	20
1879	Quarterly Journal, Vol. V.	8vo.	293
1879	List of Fellows	8vo.	16
1880	Quarterly Journal, Vol. VI.	8vo.	272
1880	List of Fellows	8vo.	16

REPORT OF THE COUNCIL

FOR THE YEAR 1880.

THE Report for the present year refers to subjects of considerable importance, and affords substantial evidence of the interest taken in Meteorology by the scientific and general public. Amongst these may be mentioned the great success of the new Climatological Stations, as shown by their increased number, and by the regularity and care with which the observations have been made and recorded, and the returns forwarded to the Society. The Council would also advert to the number of new and improved instruments exhibited at the meeting held in March last, to the increase in the number of Fellows, and finally to the numerous Papers which have been sent to the Society from various parts of the world, embracing records of the climate of several important localities, respecting which but little has hitherto been known in this country.

In the Report of Council for last year, the reasons for the establishment of the Climatological Stations are fully given, as well as the forms for recording the observations and tabulating the results for publication in the Society's Journal. The monthly abstracts have been published regularly in each number of the Journal for the present year, and will, it is hoped, be of considerable service to those desirous of ascertaining the Climatological characteristics of the different localities. It is now proposed, for purposes

of more ready comparison, to print an abstract of the observations taken at the Second Order Stations, on a plan uniform with those received from the Climatological Stations. As the number of our stations of the Second Order is 24, and of our Climatological 50, there are now altogether 74 stations in connection with the Society at which these strictly comparable observations are taken.

As it is of the greatest importance that the instruments and screens used, as well as the mode of exposure, should be as far as possible strictly uniform, the Assistant-Secretary, Mr. Marriott, has, by direction of the Council, made an inspection of most of the climatological and a re-inspection of many of the second order stations during the year, and the remaining climatological stations will be inspected in 1881. The cost of the inspection was £70. This expenditure, however, will be reduced to £45 by a grant from the Meteorological Office, as explained further on; and, though this is a serious charge on the Society's income, it is one which cannot be avoided and must recur every year, re-inspection at short intervals being necessary, in order to see if any alterations have been made in the instruments or in their manner of exposure. Mr. Marriott's report on his visit to the stations is very satisfactory.

"INSPECTION OF STATIONS, 1880.

"The following Second Order and Climatological Stations have been inspected, and, on the whole, found in a satisfactory condition, viz.:—

Alnwick
Aspley Guise, Woburn
Babbacombe, Torquay
Bournemouth
Bude
Cheltenham
Cranleigh, Guildford
Cromer
Croydon
Cullompton
Dartmoor, Prince Town
Downside, Radstock
Eastbourne
Finchley
Harestock, Winchester
Hillington, Lynn
Ilfracombe
Isleworth
Lowestoft
Lymington
Macclesfield
Maker, Devonport
Marlborough
Portsmouth
Ramsgate
Rounton, Northallerton
Seathwaite, Borrowdale
Sidmouth
Somerleyton, Lowestoft
Southampton
South Bourne, Christchurch
Strathfield Turgiss, Winchfield
Swarraton, Alresford
Throcking, Buntingford
Teignmouth, (Bitton)
,, (Woodway)
Torquay, (Castle College)
,, (Rocombe)
Totnes
Tunbridge
Tunbridge Wells
Ventnor
Watford
Weston-super-Mare
Worthing

"With regard to the Climatological Stations, the exposure, with one or two exceptions, is very good, and at some of the sea-side places is much better than might have been expected. At all the stations, except Cromer and Ilfracombe, Stevenson's stand, or a modification thereof, is used. The thermometers which had not recently been verified were compared with the standards, and their changes of index error (if any) ascertained. At one station where the thermometers had been verified about 12 years ago, it was found that the zero of the dry bulb had risen 0°·6 and that of the wet bulb 1°·0; thus making the locality to appear to be more humid than was actually the case.

"The evaporation of spirit to the top of the tube in the grass minimum thermometer is still a frequent cause of error in the readings of this instrument at some stations, and will doubtless continue to be so until some simple mercurial minimum thermometer has been devised to supersede it.

"All the observers appear to be desirous of co-operating with the Society in its endeavour to collect reliable data for ascertaining the climate of the country, by doing their best to make accurate observations, and by carrying out any suggestions that have been made for their improvement.

(Signed) "WILLIAM MARRIOTT."

The Rev. W. C. Ley has also visited the station at Guernsey, and Mr. Scott the station at Limavady, Ireland.

Applications, by persons proposing to become observers, have been made, either for the loan of instruments, or for a subsidy towards their purchase. These are rarely entertained, as much difficulty is usually found in securing the return of instruments on the death or removal of those to whom they have been lent, and in their replacement if broken. An exception, however, has been made as regards Seathwaite in Borrowdale, which has been equipped, at an expense of £7, as a Climatological Station, the observer at which is to be paid £2 2s. per annum for making the observations and forwarding them to the Society. The observer at Dartmoor also is paid £3 3s. a year for similar, but rather heavier, duties. The reasons for these departures from the usual custom are, that Dartmoor, being the highest of the Society's Stations, is of peculiar importance, and that no one there will undertake the work except the person now employed; whilst the neighbourhood of Seathwaite is probably the wettest inhabited locality in Europe, the mean annual rainfall being about 140 inches, and it is, therefore, a spot whence details of temperature and hygrometry will be of exceptional interest. There are no residents at the place except cottagers, who, of course, have had to be taught, and will have to be paid.

The Society now supplies the Meteorological Office with copies of monthly returns from 14 Second Order Stations, viz.:—

Babbacombe	Dartmoor	Ramsgate
Buxton	Hillington	Scaleby
Carmarthen	Kelstern	Strathfield Turgiss
Cheltenham	Llandudno	Wakefield
Churchstoke	Marlborough	

Scaleby having been substituted this year in the place of Audley End, where observations have been discontinued.

Weekly returns are also forwarded to the Meteorological Office from nine stations, viz.:—

Blackpool	Hillington	Llandudno
Burghill	Kelstern	Marlborough
Churchstoke	Leaton	Strathfield Turgiss

for the Weekly Agricultural Weather Reports; four of which, viz. Churchstoke, Hillington, Kelstern and Llandudno, have received sunshine recorders on loan from the Meteorological Office. Copies of the observations from Limavady are also supplied to the Registrar-General for Ireland; so that the observations taken at the Society's Stations are not only regularly published in the Journal, but appear in other and more widely distributed publications. The Meteorological Office will contribute above £100 for the Returns, and £25 towards the expenses attendant on the inspection of stations for this year. This arrangement is considered to be satisfactory to both parties.

The returns sent in to the Society, in response to inquiries, respecting the great frost of December 1879, which were embodied by Mr. Marriott in a Paper published in the April number of the Journal, showed the necessity for having not only minimum, but ordinary thermometers verified below 32° F. The Council, therefore, brought the subject under the consideration of the Kew Committee, and received an answer in February from Mr. Whipple stating that after duly considering the desirability of having dry, wet and minimum thermometers verified down to zero, the Committee were of opinion that a series of experiments should be instituted to ascertain the most desirable method of verifying thermometers at this temperature, and in the meantime were willing to verify minimum thermometers down to 12° F. for a fee of 1s. 6d. for the certificate. This is an important step towards obtaining comparable observations at low temperatures, but it is hoped that verification down to zero will soon be obtainable at a small fee, as observations show that a temperature even below this is not very uncommon in several parts of these Islands.

At a meeting of the Council, held on May 19th, the programme of questions to be submitted to the Conference for Agricultural Meteorology was read, and referred to the General Purposes Committee for consideration and report. At the next meeting of Council it was reported that the programme had been printed and sent round to the Members of Council, with a request for their suggestions. A Special Committee, consisting of the President, the Secretaries, Mr. Dymond, Mr. Ellis, Dr. Gilbert, and the Rev. T. A. Preston, was appointed to consider the programme and report thereon, and also to report on the questions to be discussed at the approaching meeting of the International Committee of Meteorology, to be held at Berne.

At a meeting of Council, held on July 14th, the following Report from the Committee was read:—

"Report of the Agricultural Meteorology Committee.

"The Committee has carefully considered the Programme of Questions to

be discussed at the Conference for the development of Agricultural and Forest Meteorology, to be held at Vienna in September, as well as Miss Ormerod's answers to the several questions of the Programme, and recommends that the following replies be sent to the Conference:—

"I. Q.—'What are the mutual relations of the Meteorological elements on Vegetation; not only those which are proved to exist, but those which are theoretically supposed to be probable?'

"A.—Healthy vegetation depends on due proportion of warmth, moisture and light; in overcast and moist summers there is luxuriant leafage and little flower; in sunny and dry summers leafage is moderate and flowering great (possibly no great amount of fruit, as the plants may be too much dried). These main points are much modified by circumstances that affect the ground temperatures, and these ground temperatures are of great importance, as through them the flow of the sap may be retarded or entirely checked, or may be active in one part of the plant whilst it is exactly the reverse in the other, *i.e.* above or below ground, as the case may be. The importance of this consideration is practically acknowledged by vine growers, and more information *on* and practical working *of* the subject would be of great service in the management of crops. The effect of a mild, overcast and moist summer and autumn or the reverse upon the ripening of the wood of that year, and the fruit and leaf buds for the succeeding year, is probably considerable, and more information on this subject is desirable; as also the effect on agricultural seeds, especially with regard to the cereal crops, as exemplified in the bread made from corn harvested in bad seasons (notably in 1839) drawing out into long sticky strings.

"With respect to the allegation that the removal of trees from large districts produces a sensible effect on the character and amount of the rainfall and upon the temperature and hygrometry of the district, the extent of the British Isles is not sufficiently great to afford positive information.

"II. Q.—'What observations of Meteorological elements are to be particularly attended to, with special reference to their influence on Vegetation?'

"A.—Sunshine, earth temperature at depths not exceeding 4 feet, air temperature and range, humidity, wind, rain and terrestrial radiation. Also solar radiation and evaporation if satisfactory instruments can be obtained.

"III. Q.—'How far and in what way can Meteorological observatories and stations, without interfering with their other work, include these observations in their sphere of operations?'

"A.—The additional data required would not materially increase the work at existing stations.

"IV. Q.—'Would it not be useful, with a view of establishing special systems of observations, such as, for instance, phenological observations, for this object, to prepare general Instructions?'

"A.—Yes. The Instructions issued by the Society are forwarded herewith.

"V. Q.—'Can, at the present moment, Meteorological Central Offices issue Weather Forecasts for the use of Agriculture with reasonable prospects of utility; and if this question be answered in the affirmative, how can the *service be organised* as fully as possible?'

"A.—The results of the first experiments in this country by the Meteorological Council are submitted herewith.

"The Committee does not consider it necessary for the Council to reply to any of the questions on the circular announcing the Meeting of the International Committee of Meteorology on August 9th, 1880, at Berne.

(Signed) "G. J. SYMONS,
Chairman."

This Report was adopted and forwarded to Vienna by the Foreign Secretary, and in Appendix III. will be found the Resolutions of the Conference. (p. 117.)

The weather in the Atlantic during the months of February and March, 1880, having been very unusual, it was considered that a careful discussion of the logs of vessels sailing in the North Atlantic during these months would be of considerable value. It was therefore resolved, at a meeting of Council, that the Meteorological Council be requested to undertake a complete discussion of the Meteorology of the North Atlantic Ocean during these months. The Council trust that a favourable answer will be received to this request.

Amongst the most valuable donations to the Library may be mentioned the printed discussion of the Cobham Journals, made and published by Miss Ormerod, who not only gave a copy to the Library, but also most liberally placed 500 copies of the work at the disposal of the Council for distribution among the Fellows of the Society. A cordial vote of thanks was given to Miss Ormerod for her valuable donation. Mr. Greaves, the late President, also presented to the Society a set of the Journals of the Royal Agricultural Society from 1839 to 1874.

The Council have purchased all the published volumes of the new edition of the Encyclopædia Britannica, and have decided on procuring the other volumes as soon as issued. They have also added to the Library Keith Johnston's Royal Atlas (new edition), as well as a considerable number of old and rare meteorological works.

In consequence of the number of works presented to the Society, lists of which will be found in Appendix IV., it has been found necessary to provide additional shelves for their accommodation. Considerable attention has also been given to perfecting the sets of serial publications, to keeping the Library in a satisfactory and creditable state as to binding, and also to keeping the slip catalogue perfect. The insurance of the Library has also been increased from £250 to £500.

The Council desire to advert specially to the contents of the Journal for the past year, which they consider will compare favourably with any volume previously issued. As the exhibition of instruments at the March meeting was the first held in accordance with the resolution passed in 1879, the Council desire to draw attention to the descriptive list printed on pages 161-5 of Vol. VI. of the Journal. They would also especially mention the following list of published Papers, which show the varied character and valuable contents of the volume for 1880, viz.:—

"*Report on the Phenological Observations for* 1880." By the Rev. T. A. PRESTON, M.A., F.M.S.

"*Notes on the Meteorology of Zanzibar, East Africa.*" By JOHN ROBB, M.D., F.M.S.

"*On a New Form of Hygrometer.*" By GEORGE DINES, F.M.S.

"*The Diurnal Range of Atmospheric Pressure.*" By RICHARD STRACHAN, F.M.S.

"*Description of the Card-Supporter for Sunshine Recorders adopted at the Meteorological Office.*" By Prof. G. G. STOKES, M.A., F.R.S.

"*On Typhoons in China,* 1877 *and* 1878." By Lieut. A. CARPENTER, R.N., F.M.S.

"*Notes on the Reports of Wind Force and Velocity during the Tay Bridge Storm, December* 28*th,* 1879." By ROBERT H. SCOTT, M.A., F.R.S.

"*On the Frost of December* 1879, *over the British Isles.*" By WILLIAM MARRIOTT, F.M.S.

"*Comparison of Thermometric Observations made on board the R.M.S.S.* '*Algeria,*' by Capt. WILLIAM WATSON, F.M.S., *during* 5 *passages between Liverpool and New York, in September to December,* 1878."

"*On the Greenwich Sunshine Records,* 1876-80." By WILLIAM ELLIS, F.R.A.S.

"*On the Rate at which Barometric Changes traverse the British Isles.*" By G. M. WHIPPLE, B.Sc., F.R.A.S.

"*A Sketch of the Winds and Weather experienced in the North Atlantic, between latitudes* 30° *N and* 50° *N, during February and March,* 1880." By CHARLES HARDING, F.M.S.

"*A New Form of Six's Self-registering Thermometer.*" By J. W. ZAMBRA, F.M.S.

"*Variations in the Barometric Weight of the lower Atmospheric Strata in India.*" By Prof. E. DOUGLAS ARCHIBALD, M.A., F.M.S.

"*Meteorology of Mozufferpore, Tirhoot, for the year* 1879." By CHARLES N. PEARSON, F.M.S.

"*Ozone in Nature, its Relations, Sources and Influences, &c.*" By JOHN MULVANY, M.D., R.N., F.M.S.

"*The Average Height of the Barometer in London.*" By HENRY STORKS EATON, M.A., F.M.S.

"*Results of Meteorological Observations made at Stanley, Falkland Islands,* 1875-77." By WILLIAM MARRIOTT, F.M.S.

"*The Winter Climate of Davos.*" By C. THEODORE WILLIAMS, M.A., M.D., F.M.S.

The cost of the Journal for the year has been somewhat high, chiefly in consequence of the unusually large number and size of the illustrations, and partly from the increased number of copies now required for the Fellows. The total cost of publication exceeded £200, to which must be added the amount expended for postage in forwarding copies to the Fellows, and to the numerous Foreign Societies and individuals with whom publications are exchanged. The labour in superintending the publication of the Journal has

been unusually great, and the best thanks of the Society are therefore due to the Editing Committee.

The delegates appointed to represent this Society upon the Lightning Rod Conference report that that body has been steadily at work during the past year, eleven meetings have been held, nearly 200 pages of the Appendices to the Report are in type, and it is hoped that the Conference will complete its labours during the present session.

In consequence of the additional labour thrown upon the staff by the comparison of the returns from the Climatological Stations, it has been necessary to appoint another computer, and thus add somewhat to the annual cost of the staff. The total expenditure for the year, as might have been expected, is greater than in former years, partly from the increased rent of the Society's Offices, but chiefly from the additional amount paid in salaries (about £32), postage of the Journal, and the inspection of new stations.

The Society has to deplore the loss by death of two of the Fellows, viz. Edward Chapman Morrell, elected on January 15th, 1879, and Henry Downs, elected March 19th, 1879; and the roll of the Society has also been diminished by 14 resignations, and the removal of 10 defaulters, making a total loss of 26, against 52 Fellows elected in 1880.

Fellows.	Life.	Ordinary.	Honorary.	Totals.
1879, December 31 ... (Corrected numbers)	91	366	16	473
Since elected	+ 8	+42	+ 2	+52
Since compounded	+ 4	− 4	...	0
Deceased	...	− 2	...	− 2
Retired	...	−14	...	−14
Defaulters	...	−10	...	−10
1880, December 31 ...	103	378	18	499

The following figures show the position of the Society for every year since it procured a Charter of Incorporation in 1866 :—

1866.....331	1871.....314	1876.....398
1867.....328	1872.....309	1877.....417
1868.....330	1873.....308	1878.....425
1869.....341	1874.....327	1879.....473
1870... ..340	1875.....358	1880.....499

The Standing Committees were constituted as follows :—

Editing Committee :—Mr. Laughton, Mr. Scott and Mr. Whipple.

General Purposes Committee :—The President, the three Secretaries, Mr. Ellis, Mr. Latham and Mr. Tabor.

Decrease in Water Supply Committee :—The President, Messrs. Eaton, Field, Greaves, Latham and Scott.

The receipts and expenditure during the year do not compare so favourably

as in preceding years, the former having been £691 8s. against £705 18s. 10d. expended. But this has arisen, to a certain extent, in consequence of the non-receipt of £50 from the Meteorological Office before the close of the year. The purchase of books has absorbed about £16 more than usual, the additional salaries £32, and the large cost of inspecting the new and some of the old stations nearly £27 above the sum expended last year, which altogether fully account for the increased expenditure. The entrance fees for 1880 were less than in 1879, having been only £47 against £80 in the latter year; the life compositions were the same, and the subscriptions nearly £2 10s. less than in 1879. On the other hand, the excess of assets over liabilities, including the £50 due from the Meteorological Office, reaches to nearly £115 above the amount in 1879. The following summary shows the receipts for the last three years from subscriptions, entrance fees and life compositions:—

	1878.	1879.	1880.
Subscriptions	£316 18 0	£357 14 0	£355 2 0
Entrance Fees	87 1 0	80 4 0	47 0 0
Life Compositions ...	86 0 0	144 0 0	144 0 0
	£389 19 0	£581 18 0	£546 2 0

APPENDIX I.

REPORT OF THE ASSISTANT SECRETARY ON THE INSPECTION OF STATIONS, FOR THE YEAR 1880. (Plate V.)

ALNWICK, *December* 21.—This station has been organised jointly by Mr. J. H. Stewart and Mr. J. Lingwood, the former having purchased most of the instruments and the latter having undertaken to make the observations. The instruments are placed in a good sized garden at the eastern end of the town, near the railway station; the situation is open and exposed, with ground sloping a little to the north. The thermometer-stand is a large one with single louvres; Mr. Lingwood was requested to have additional louvres fixed on three sides so as to cut off reflection and radiation from the ground. The subsoil is sandy.—*Observer*, J. LINGWOOD, F.M.S.

ASPLEY GUISE, *July* 2.—This station is two miles north-north-west of Woburn, and is on the summit, and at the east-north-east end of a range of hills which run from WSW to ENE, and is very open and exposed on all sides except the west, on which there is a wood about a quarter of a mile distant. The instruments are placed on the west side of the lawn, on the border of which there are a great number of shrubs, &c. The thermometer-stand is a home-made one and not of the regular Stevenson pattern; the dry-bulb is at one side and the wet-bulb at the other, with the maximum and minimum thermometers between them. The soil is sandy.—*Observer*, E. E. DYMOND, F.M.S.

STATIONS
OF THE
METEOROLOGICAL SOCIETY
1881.
Second Order Stations thus Alnwick.
Climatological Stations ....,.... Alston.
Alnwick
Alston
Cockermouth
Southwaite
Bowston
Scarborough
St Michaels-on-Wyre
Blackburn
Holmfield
Hadnock
Macclesfield
Buxton
Chester
Mansfield
Oakamoor
Parley
Belper
Cheadle
Spalley
Leighborough
Gromer
Hillington
Somerleyton
Lowestoft
Leeton
Churchstoke
Kenilworth
Berghill
Aspley Guise
Throcking
Ross
Cheltenham
Carmarthen
Cardiff
Marlborough
Westford
Ickleford
Bayards Park
Southmill
Berwood
South Norwood
Croydon
Penshurst
Tunbridge
Tunbridge Wells
Weston-super-Mare
Downside
Stapleton Burglass
Abbotsham
Swanleigh
Swanton
Harestock
Southampton
Worthing
Eastbourne
Gillingham
Bude
Brampford Speke
Dartmoor
Ashburton
Bridgetown
Guernsey
West Long.
East Long.
Malby & Sons. Lith.

UNCLASSIFIED

BABBACOMBE, *August* 21.—On testing the thermometers it was found that the zero of the maximum thermometer had risen 0°·2, and also that the dry- and wet-bulbs read a little too high. In all the other respects the station was in a satisfactory condition. Since the last inspection Mr. Glyde has had a tower built over the porch of the house, on the top of which he has erected a Casella self-recording anemometer. This commands a good view, but the wind is so much deflected by the cliffs and the contour of the land that the anemometer hardly registers the true amount. Soil limestone.—*Observer*, E. E. GLYDE, F.M.S.

BOURNEMOUTH, *July* 24.—The thermometer-stand is placed in the vegetable garden of Tregau House on the east cliff, and is fairly well exposed considering the neighbourhood, as in Bournemouth there are great numbers of fir trees. The rain-gauge is on the lawn in front of the house in an open situation. The dry and wet-bulb thermometers are not graduated on their stems. The soil is sandy.—*Observer*, ADMIRAL SIR B. J. SULIVAN, K.C.B.

BRIDGETOWN, TOTNES, *August* 21.—The instruments are placed in a garden in front of the house in a fairly open situation. Bridgetown lies in the valley of the Dart, and the garden is on the NE slope about 100 feet above the river. The thermometer-stand is larger than the usual pattern and has zinc louvres instead of wooden ones. As the area for the rain-gauge was too confined the observer was requested to move it some feet further to the south. The soil is clay.—*Observer*, T. H. EDMONDS, F.M.S.

BUDE, *August* 14.—The thermometer-stand is placed on a small grass plot in front of the school-house, the walls of which are coloured white. A roadway runs on the south-west side of the garden, so that possibly there may be a little reflection and radiation of heat. The stand is a large open one with only single louvres and was painted green; the bulbs of the thermometers were also only 8 feet above the ground. The observer was requested to raise the stand and have it painted white, and also to provide for a better circulation of the air. The rain-gauge is placed in the grounds of the Castle and is very well exposed, no object rising beyond an altitude of 10°. Bude is situated in a cove on the north coast of Cornwall in a valley running some little distance inland north-west and south-east, and is exposed to the full force of wind from the sea. The soil is sand, but the valley itself is bounded by iron-stone rocks and hills.—*Observer*, J. ARTHUR.

CHELTENHAM, *August* 10.—The observer was away from home at the time of my visit, so a complete inspection could not be made. The instruments appeared to be in good working order except the grass minimum thermometer, which had some spirit at the top of the tube. The cotton on the wet-bulb thermometer was also too thick. Soil, loam on clay.—*Observer*, R. TYRER, B.A., F.M.S.

CRANLEIGH, *September* 24.—The instruments are temporarily placed in a garden at the end of a large common in a well exposed situation. They are to be removed to a new site in the course of a few months outside the vegetable garden of Alderbrook, the seat of Mr. Ralli, M.P., 7 miles south-east of Guildford. This position is rather sheltered by trees and hills from the S to E, but is well open to the SW. A hill rises to the height of about 800

feet above sea level on the north-east, and the ground slopes gently to the south-west. Soil sand on clay.—*Observer*, J. BRYAN.

CROMER, *July* 8.—The thermometer-stand is a home-made one, and was entirely closed except at the bottom which had perforated holes, and was painted black. As the observer was not disposed to procure a Stevenson screen, he was requested to have the stand painted white and to have holes made at certain parts of the sides to allow for ventilation. The garden is very much enclosed, so that the exposure is not so good as might be desired. The thermometer-stand is close to the house and also a wall on the south, so that it is in shade in the morning. As the rain-gauge was almost overhung by a tree on the south-west side, a fresh site was selected for it a little further to the north-east. The town is very much confined, the houses being close together with little or no garden, and the streets very narrow, so that a sufficient exposure for meteorological observations is almost impossible. Sandy soil.—*Observer*, J. COOPER, F.R.C.S.

CROYDON, *June* 29.—This station was found to be in a satisfactory condition. Since the last inspection a sunshine recorder has been added to the instruments in use and is mounted on the chimney-stack. Sandy soil.—*Observer*, E. MAWLEY, F.M.S.

CULLOMPTON, *August* 26.—The instruments are placed in a garden 40 feet wide, and very long and open. The ground in the garden is almost level, but in the neighbourhood falls slightly to the river Culm, which is barely half-a-mile to the east. The soil is gravel with a little clay.—*Observer*, J. TURNER, F.M.S.

DARTMOOR (PRINCETOWN), *August* 16.—The thermometer-stand is placed in the vegetable garden adjoining the Prison Officers' School, and is well exposed. The stand was painted black, but the observer was requested to have it painted white forthwith. The rain-gauge had been moved from the site previously selected to a small garden or yard, to which cattle had access, and was in a very unsatisfactory condition. The observer agreed to have the gauge re-turned in a lathe, and to remove it to its former position. The soil is peat on granite.—*Observer*, W. H. TOOKER.

DOWNSIDE, *August* 27.—As the building of the Monastery Church was being rapidly proceeded with, the instruments were removed in 1879 about 80 feet to the south of their former position. The stand was placed close to a gravel walk with the door opening to the south. As there appeared to be some reflected heat from the path the observer was requested to place the stand about 10 feet further back, with the door opening to the north. Soil, clay.—*Observer*, REV. T. L. ALMOND, O.S.B., F.M.S.

EASTBOURNE, *July* 21.—The instruments at this station were in a satisfactory condition, except the grass minimum thermometer, which had some spirit at the top of the tube. As the rain-gauge was rather rusty the observer undertook to procure a new 5-inch Snowdon gauge. Soil, chalk.—*Observer*, S. BRETTON, F.M.S.

FINCHLEY, *December* 30.—The instruments not being in position, a site was selected for the thermometer-stand and rain-gauge in a very open

situation. There is a large pond some 70 feet south of the thermometer-stand, but it is about 15 feet below the level of the ground where the stand is placed. The station is in the extensive grounds belonging to Avenue House, which Mr. Stephens is having laid out. The natural soil is clay, but a good deal of the ground is 'made soil.'—*Observer*, H. C. STEPHENS, F.M.S.

GUERNSEY, *July* 29.—The instruments are placed in a large garden in the western district of St. Pierre, on the north side of a slight valley which runs down from the west to the sea; the ground on the immediate north is nearly level, on the south it falls about 1 in 9 to the south, while the whole slope of the valley is at this place only 1 in 12 west to east. The garden itself is lowest on the south-west. The neighbourhood is moderately well exposed, with numerous adjacent houses and some timber. The soil is entirely gravel. The observer has no deputy, so that the returns are liable to be incomplete during his absence. (Inspected by Rev. W. C. Ley.)—*Observer*, Dr. F. E. CAREY, F.M.S.

HARESTOCK, *July* 28.—This station is about 2 miles north-west of Winchester, and is exceedingly open and exposed, commanding a wide expanse of country. All the instruments were in a satisfactory condition. The soil is chalk.—*Observer*, Lieut.-Col. H. S. KNIGHT, F.M.S.

HILLINGTON, *July* 10.—As there appeared to be a little radiation reaching the thermometers owing to the louvres being rather wide apart, the observer was requested to have some additional louvres put in the stand, and also to have the frame carrying the thermometers made firmer. Soil, sand on chalk.—*Observer*, Rev. H. FOLKES, M.A., F.M.S.

ILFRACOMBE, *August* 12.—The instruments are exposed in a large screen, like a summer-house, the rain-gauge being on the top and having a pipe with a tap below. The stand is about 6 feet square, has large louvres half-way down, then lattice work, is painted green and has a slated pyramidal roof. It is placed over the shingle promenade of the Ilfracombe Hotel, and is 8 or 10 feet from the embankment, which rises about 16 feet. The exposure is quite open to the sea from the west to north. Capstone rock is about 200 yards distant on the north-north-east. On the borders and outskirts of the town, hills rise to the height of 500 to 800 feet. The whole of the soil is shale. During 1880 the returns were supplied by Dr. Slade-King, who extracted the readings from a local paper. Since then the Directors of the Ilfracombe Hotel have instructed their observer, Mr. Tattam, to send the returns direct to the Society. A new rain-gauge has also been procured and placed in a better position than the one on the top of the stand. —*Observer*, M. W. TATTAM.

ISLEWORTH, *June* 29.—The instruments are placed in the kitchen-garden, in an open and exposed situation, and were found in a satisfactory condition, except the grass minimum thermometer, in which the spirit had become divided. Miss Ormerod undertook to have an apple tree on the north-east removed, so that there might be no obstruction to the rain-gauge. The ground in the immediate neighbourhood is level, and the soil clay.—*Observer*, Miss E. A. ORMEROD, F.M.S.

LOWESTOFT, *July* 7.—This station was found in a satisfactory condition. As the shrubs and trees round the garden had grown very much, the observer was requested to have the tops of the trees cut on the north and north-east sides. Mr. Miller will remove in a year's time to a new house about 100 yards west of the present situation. The soil is gravel.—*Observer*, S. H. MILLER, F.M.S.

MACCLESFIELD, *December* 28.—A plot of ground 12 feet square has been railed off in the Public Park for the mounting of the instruments. The situation is very open, there being only a few shrubs on the west and south; the ground slopes to the north towards the river Bollin, which is at the end of the Park. The instruments were not in position, but the stand was erected and painted green. Mr. Dale undertook to have it painted white. The observations for the first few months will be taken by Mr. Dale, the Secretary of the 'Useful Knowledge Society,' and afterwards by the Park-keeper as soon as he is capable of making them. The soil is gravel on clay. —*Observer*, J. DALE.

MAKER, *August* 17.—This station is on Maker Hill, a little above, and to the south-west of Mount Edgecumbe, and about one-third of a mile from the sea. The instruments are in the garden on the north slope of a valley which runs nearly north-east and south-west; the valley is open on the east to Plymouth Sound. The thermometer-stand is not of Stevenson's pattern, but a home-made one. The stand proper has louvres on three sides and a plain board at the back in which a number of circular holes are cut. This stand is protected by an outer screen of plain boards all round except on the north side. It seemed to allow for a good circulation of air, but Mr. Newnham was requested to provide for a little more ventilation. As the rain-gauge was rather sheltered by trees on the north and east a fresh site was selected for it on the terrace above the lawn. Soil, clay on rubble-stone.—*Observer*, Rev. P. H. NEWNHAM, M.A., F.M.S.

MARLBOROUGH, *July* 29.—This station was found to be in a satisfactory condition and all the instruments were in good working order. Soil chalk.—*Observer*, Rev. T. A. PRESTON, M.A., F.M.S.

PORTSMOUTH, *July* 22.—The instruments are placed in a large vegetable garden on the west side of Trinity Church, Portsea, and close to H.M. Dock-yard. The ground is level and the situation open. The thermometer stand is larger and higher than the usual Stevenson pattern. The dry and wet thermometers are long instruments with pear shaped bulbs and have the scales protected by outer tubes. The rain-gauge, which had been made by a convict in the prison, had a broad wire rim. This has since been altered to a sharp rim. Soil, loam on sand.—*Observer*, R. E. POWER, L.R.C.P.

RAMSGATE, *September* 9.—This station was not in a very satisfactory condition. The muslin on the wet-bulb was found to be dry, and the cup, containing the water, green. The muslin and cotton which had been sent on the thermometer, in November last, had not been changed till a few days before. The porcelain scale of the minimum thermometer had been broken for a long time, and consequently only the divisions on the tube had been used. This

may have been the cause of occasional errors of 5° or 10°. I re-fixed the scale so that the instrument can now be read correctly. The thermometer attached to the barometer was broken the morning of my visit; this has been replaced by a spare centigrade thermometer which I compared with the standard. The maximum thermometer in the sun was broken by the gardener a few weeks previously, and the grass minimum had been broken for some months. Soil, chalk.—*Observer*, Rev. T. E. EGAN, O.S.B.

ROUNTON, *December* 22.—The instruments were not in position, but a site was selected for them on the lawn in a very open situation and about 300 feet from the house. The district appears to be rather flat and moderately free from trees, there are, however, some hills about 200 feet in height, 2 or 3 miles distant in the SW. Rounton is 7 miles north-east of Northallerton. The soil is marl on sandstone.—*Observer*, I. LOWTHIAN BELL, F.R.S., F.M.S.

SEATHWAITE, *December* 18.—It being considered desirable to ascertain the meteorological characteristics of this, the wettest spot in Europe, the Council decided upon equipping a climatological station, the observations being made by the same person who has hitherto measured the rainfall there. I visited this place on the above date, took the instruments with me, had them properly set up, and gave the observer full instructions. Seathwaite is in a valley at the southern end of Borrowdale, and is at the foot of two high hills, viz. Glaramara, which rises to the height of 2,560 feet on the SSE, and the Wadd Hole Moor, which is nearly 2,000 feet high on the NW. The Great Gable, 2,949 feet, is about 2 miles to the SW. The instruments are placed in a small garden surrounded by a low stone wall (4½ feet high) belonging to one of the cottages. The stand will be in shade for some time every day, as may be gathered from the fact that in winter the sun shines there only for about two hours.—*Observer*, W. DIXON.

SIDMOUTH, *August* 25.—The instruments are placed in an open and well exposed situation in the outskirts of a vegetable garden, on the summit of a small hill in the valley between the Salcombe and Peak Hills, which rise to the height of 500 feet and are about 4 miles apart. The thermometer stand, which is of Dr. Radford's own design, is a double one, somewhat like the old Kew stand. The maximum and minimum thermometers are fixed to a vertically revolving board so that they can be set by one movement. The rain-gauge is on the lawn in front of the house, and is somewhat protected by high trees. The soil is clay.—*Observer*, Dr. W. T. RADFORD, F.M.S.

SOMERLEYTON, *July* 9.—The instruments are placed on the lawn in the rectory grounds, in Somerleyton Park, 5 miles west-north-west of Lowestoft. The district is rather wooded, but the thermometer stand has a good exposure. The rectory is on high ground about 50 feet above and a mile distant from the valley of the Waveney. On comparing the thermometers, it was found that the zeros of the dry and wet bulbs had risen considerably since the last comparison, the dry reading 0°·6 and the wet 1°·0 higher than when last compared. The rain-gauge was in the kitchen garden, but was not sufficiently well exposed, being protected by high trees on the north and north-east; a

fresh site was, therefore, selected for it on the lawn. The soil consists of gravel, loam and sand.—*Observer*, Rev. C. J. STEWARD, M.A., F.M.S.

SOUTHAMPTON, *July* 22.—This station is at Highfield, which is about 2 miles north of, and on higher ground than, Southampton. The instruments are placed in a garden on the south-west side of a gently sloping valley, a little to the south-east of Southampton Common, and were all in a satisfactory condition. The soil is sandy.—*Observer*, Rev. H. GARRETT, M.A., F.M.S.

SOUTH BOURNE, *July* 23.—No change has been made at this station since the last inspection. All the instruments were found in a satisfactory condition. The soil is sand.—*Observer*, Dr. T. A. COMPTON, F.M.S.

STRATHFIELD TURGISS, *July* 28.—This station was found in good working order, the only recommendation being that the stand should be painted. Soil, gravel.—*Observer*, Rev. C. H. GRIFFITH, F.M.S.

SWARRATON, *July* 27.—The village of Swarraton, which is about 10 miles north-east of Winchester, lies in a valley, the sides of which rise to about 150 feet. The instruments are placed in a piece of ground railed off in a field on the eastern side of the valley, which runs north and south; they are about half-way up the slope. There are several trees near, but the exposure is quite open. All the instruments were in a satisfactory condition. The soil is chalk.—*Observer*, Rev. W. L. W. EYRE, M.A, F.M.S.

TEIGNMOUTH (Bitton), *August* 24.—The instruments are placed in the grounds of the Bitton, West Teignmouth, which slope down to the river Teign, about 100 yards on the south. The Teign at high water is a broad river, but at low water wide sand banks are left bare. There are some high trees on the north-west to the north-east, but otherwise the situation is open from the east to west. The thermometer stand has two doors, one on the north for reading the dry and wet bulbs, and the other on the south for reading the maximum and minimum thermometers. Soil, New Red Sandstone.—*Observer*, Dr. W. C. LAKE, F.M.S.

TEIGNMOUTH (Woodway), *August* 25.—The instruments are placed in a garden on the south-east slope of the little Haldon, which rises to the height of 800 feet about a mile and a quarter on the north-west. The garden slopes to the south and is open in all directions except the north. It is distant one mile from the sea on the east, and also one mile from the Teign on the south. The thermometer stand was painted an oak grained colour, but Mr. Ormerod undertook to have it painted white. Soil, New Red Sandstone.—*Observer*, G. W. ORMEROD, F.M.S.

THROCKING, *September* 7.—This station is on about the highest ground in Hertfordshire, and a mile and a half west-north-west of Buntingford. The ground in the district is nearly level, but slightly undulating. The instruments are placed on the lawn of the rectory, which is quite level but surrounded by trees. The thermometer stand was mounted on a table and had a board with holes at the bottom. As the table was liable to get heated, the observer was requested to remove it, and to mount the stand on four posts, with the bulbs of the thermometers 4 feet above the ground. The rain-gauge was protected by trees on the north-east and east. A new site

was selected for it in the kitchen garden, where it will be open to all quarters. The soil is clay.—*Observer*, Rev. C. W. Harvey, M.A., F.M.S.

Torquay (Castle College), *August* 23.—The instruments are placed on a knoll at the apex of St. Mary Church Road and Union Street, in the parish of Upton. The summit of the knoll is comparatively level, but the ground slopes considerably all round, especially on the south-south-west, where there is a steep cliff some 60 feet in height. Trees surround the knoll, but not to any great altitude. The soil is limestone.—*Observer*, C. J. Harland, F.M.S.

Torquay (Rocombe), *August* 23.—This station is on the ridge at the west end of the Warbury Hill. The ground slopes to the south and is open to Tor Bay. Rocombe is nearly mid-way between Babbacombe and Tor Bays. The instruments are placed on a lawn which is quite level and open from the south-east to west. The soil is chiefly slate.—*Observer*, H. Hearder, F.M.S.

Tunbridge, *July* 20.—The instruments are placed in a small vegetable garden and shrubbery, surrounded by a wall 7 feet high. The ground is level, but about half a mile to the south-west there is a hill 100 feet high. The thermometer stand is a large home-made one. The observer was requested to have some ventilating holes made at the top and to replace the solid bottom by lattice work. The soil is loam on clay.—*Observer*, W. C. Punnett, F.M.S.

Tunbridge Wells, *July* 20.—This station is at Blackhurst, on the summit of the Pembury Road. The instruments are placed on the lawn and are well exposed. All the instruments were in a satisfactory condition except the grass minimum thermometer, which had 8° or 9° of spirit at the top of the tube. Soil, sandy loam.—*Observer*, F. Green, M.A., F.M.S.

Ventnor, *July* 26.—This station is in the grounds of the National Consumptive Hospital, on the Under-cliff. The instruments are placed on a grass plot behind the Hospital, which has a good expanse of grass land between it and the sea cliff, about 300 yards distant. The situation is fully open and exposed except on the north, where it is protected by the Upper-cliff, which rises to the height of about 500 feet above sea level. The observations had been taken by Mr. Ryder till June, and since then by Mr. Codling, who had had no previous instruction in the taking of meteorological observations. The instruments were compared and instruction given to the observer, so that the observations may now be considered satisfactory. The soil is green sand-stone.—*Observer*, J. Codling.

Watford, *July* 2.—The instruments are placed on the lawn in a well exposed situation. The ground in the neighbourhood slopes gently on the east towards the valley of the Colne, which is about half a mile distant. All the instruments were in a satisfactory condition except the minimum thermometer, which read about 0°·6 too low, owing to spirit having evaporated to the top of the tube. Soil, gravel on chalk.—*Observer*, J. Hopkinson, F.M.S.

Weston-super-Mare, *August* 11.—The instruments are very well exposed on level grass land at the end of the High Street, and are about a quarter of a mile from the sea beach. The thermometer stand is a home-made one, with zinc louvres inside, and was painted green. Mr. Perrett was requested

APPEN-

ABSTRACT OF RECEIPTS AND EXPENDITURE

Receipts.	£	s.	d.	£	s.	d.
Balance from last year				150	8	0
Dividend on £800 M. S. and L. R. 4½ Debenture Stock	35	5	0			
Do. £316 0s. 3d. New 3 per Cents.	9	5	3			
				44	10	3
Meteorological Office:—						
Copies of Monthly Returns from 14 Stations (9 months)	75	0	0			
Do. Annual „ 1 „	2	10	0			
Do. Weekly „ 9 „ (1879) ..	3	15	4			
				81	5	4
Subscriptions for 1878	7	0	0			
Do. for 1879	45	13	0			
Do. for 1880	291	8	0			
Do. for 1881	11	1	0			
Entrance Fees ..	47	0	0			
Life Compositions	144	0	0			
				546	2	0
Mr. E. Mawley—Publication of Observations				2	2	0
Sale of Publications				17	8	5
				£841	16	0

DIX II.

FOR THE YEAR ENDING DECEMBER 31ST, 1881.

EXPENDITURE.

	£ s. d.	£ s. d.
ournal:—		
Printing Nos. 33—36	139 15 0	
Illustrations	40 12 2	
Authors' Copies	15 19 6	
Registrar-General's Reports	7 12 0	
		203 18 8
rinting, &c.:—		
General Printing	13 0 0	
List of Fellows	6 16 0	
Forms, &c.	12 18 6	
Stationery	11 17 1	
Books and Bookbinding	33 16 6	
		78 8 1
alaries:—		
Assistant-Secretary	145 0 0	
Computers	77 10 6	
		222 10 6
ffice Expenses, &c.:—		
Rent and Housekeeper	48 4 2	
Furniture, Coals, and Insurance	12 2 4	
Postage	41 14 9	
Refreshments	11 7 2	
Parcels and Petty Expenses	4 4 6	
Commission on Irish Cheques	0 2 0	
		117 14 11
bservations:—		
Inspection of Stations	70 2 9	
Instruments	9 15 11	
Observer at Dartmoor	3 3 0	
		83 1 8
tock:—		
Purchase of £70 17s. 9d. New 3 per Cents.		70 0 0
		775 13 10
Balance:—		
In hands of Bank of England	59 9 7	
Do. Assistant-Secretary	6 12 7	
		66 2 2
		£841 16 0

We have examined the accounts for the year 1880, with the vouchers and the books of the Society, and find them to be correct,

JOHN SANFORD DYASON,
CHARLES HARDING, } *Auditors.*

anuary 6th, 1881.

APPENDIX II.—*Continued.*

ABSTRACT OF ASSETS AND LIABILITIES ON JANUARY 1st, 1881.

Liabilities.

	£	s.	d.
To Subscriptions for 1881 paid in advance	11	1	0
,, Excess* of Assets over Liabilities	1686	2	4
	£1697	3	4

* This excess is exclusive of the value of the Library and Stock of Publications.

Assets.

	£	s.	d.	£	s.	d.
By Society's Money invested in New 3 per Cents., £386 18s., at 98¼	381	2	0			
,, Society's Money invested in M. S. and L. R. 4½ Debenture Stock, £800, at 124	992	0	0			
				1373	2	0
,, Subscriptions unpaid, estimated at.....	80	0	0			
,, Entrance Fees	5	0	0			
,, Dividend on £800 M. S. and L. R. 4½ Debenture Stock	17	12	6			
,, Meteorological Office—Monthly Returns (1 Quarter)	25	0	0			
,, Meteorological Office—Weekly Returns (1880)	3	18	2			
Do. Inspection (1880)	25	0	0			
,, Mr. E. Stanford—Sale of Publications	1	8	6			
				157	19	2
,, Furniture, Fittings, &c.	40	0	0			
,, Instruments	60	0	0			
				100	0	0
,, Cash in hands of Bank of England	59	9	7			
,, Do. Assistant-Secretary	6	12	7			
				66	2	2
				£1697	3	4

JOHN SANFORD DYASON,
CHARLES HARDING, } *Auditors.*
WILLIAM MARRIOTT, *Assistant-Secretary.*

January 6th, 1881.

to have it painted white, but he could not promise to have this done, as the lady to whom the land belongs had already protested against the stand being placed there at all. I believe that the stand, however, has since been painted white. Soil sandy, but limestone in the neighbourhood.—*Observer*, W. E. PERRETT.

WORTHING, *July* 21.—The instruments are placed on a lawn in a large garden, which runs the whole length of a number of houses, and are about 200 feet from the sea shore. The exposure is very open except on the south, where the houses on the Marine Parade cut off the sun's rays for some time in the winter. The soil is gravel upon chalk.—*Observer*, W. J. HARRIS, M.R.C.S., F.M.S.

APPENDIX III.

RESOLUTIONS ADOPTED BY THE CONFERENCE FOR THE DEVELOPMENT OF AGRICULTURAL AND FOREST METEOROLOGY, HELD AT VIENNA IN SEPTEMBER, 1880.

QUESTION I.

"What are the mutual relations between the meteorological elements and vegetation, not only those already investigated, but those theoretically supposed to exist?"

RESOLUTION.

1.—Vegetation is materially dependent on the following meteorological elements:—

a. Temperature of the air and the soil.

b. Duration and intensity of the illumination.

c. All the hydrometeors; consequently the vapour tension and relative humidity, precipitation (rain, snow, &c.), as well as the other forms of condensation (fog, dew, and hoar frost).

d. Motion of the air. On the other hand, the daily march of pressure, and of ozone, appear to be of less importance for the march of vegetation.

2.—Conversely, the meteorological elements appear to exhibit the influence of vegetation in the following way:—Vegetation on augmented scale (such as pasturage, tilled land, forests, and moorland, &c.) give rise each in their own districts to special conditions of temperature and atmospheric humidity, and perhaps of rain also, and may therefore exert an influence on the climate of the surrounding country, in respect of temperature and hydrometeors, and also of springs.

QUESTION II.

"To what observations of meteorological elements is particular attention to be paid with special reference to their influence on vegetation?"

3.—On the whole it appears important that on as many rationally managed estates as possible, special observation should be carried on of all the elements recognised as important. These observations should be made in different soils, and with different types of culture, and should be compared with the crop returns year by year, so as to investigate in detail the relation between vegetation and climatic factors.

The general mean results published by the several central institutes do not furnish values in sufficient detail for the study of individual types of culture, or of local conditions.

4.—The Conference approves of Dr. Hann's proposal, that Governments and Agricultural Societies be recommended to set on foot such organisations of stations for agricultural meteorology as shall render it possible to ascertain the conditions of climate required by the most important crops, not only in the region where

they attain their highest perfection but also at the extreme limits of their cultivation.

With regard to the individual meteorological elements, the discussion on Question II. led to the following results :—

5.—It is recommended that comparative experiments on the best modes of thermometer exposure be conducted.

(A description of the modes of exposure adopted in different countries will be forwarded to the members of the Conference as soon as the necessary particulars have been collected by circular.)

6.—*Hours for daily observation.*—The Conference expresses its opinion that when two observations only can be taken it is preferable to take these in the morning and evening, but that observations of the maximum and minimum temperature should also be made.

7.—*Insolation.*—As no thoroughly satisfactory actinometer is known, observations should in the first instance be made, but at stations of the first order only, of the time, duration, and relative intensity of sunshine (the last named by means of sensitised paper).

It is recommended as an important inquiry for scientific institutes to devise an actinometer which shall be applicable to the sums of temperature derived from solar heat.

8.—*The temperature of the soil* should be measured at least at four levels between the surface and the depth of 3 ft. 3 ins. (1 metre), and be conducted in various soils and with various kinds of crops, &c. This investigation most properly belongs to scientific agriculturists and foresters, and to technical experimental stations.

9.—*The occurrence of frosts.*—Observations are particularly to be made. It is a subject well worth study as to the best mode of registering these observations in a form useful for practical discussions. Of course minimum thermometers should be used, but only such as have the bulbs quite free of the mounting.

10.—It seems most important that the relation between the radiation under a cloudless sky and the humidity of the atmosphere should be carefully studied at stations of the first order.

11.—*Light.*—The methods of photometric observation, with especial reference to the chemical action of light, should be perfected by experiment at scientific institutions, in order to obtain a good chemico-photometric instrument.

12.—THE HYDROMETEORS.—*The humidity of the air* should be measured by the dry and wet bulb thermometers and the hair hygrometer, and, if possible, three times a day (one observation being taken in the early afternoon).

As to the apparatus to be used the Conference recommends comparative observations with the complicated balance hygrometer of Schwackhöfer, and the more simple apparatus of Edlmann of Munich, in order to determine which of these arrangements should be finally recommended for stations of the first order.

The stations of the second and third orders should for the present employ only the dry and wet bulb hygrometer and the hair hygrometer.

13.—*Evaporation.*—The Conference is of opinion that observations are important, but that no existing instrument can be proposed for general and exclusive use. In fact, it is recognised as an immediate requirement to devise satisfactory instruments, and especially such as would admit of the accurate measurement of evaporation, not only from free water surfaces, but also from different soils in the fallow and cropped state.

Meanwhile, observations on evaporation should not be neglected, but they should be conducted with simple forms of apparatus, especially those depending on weight, as well as with Piche's atmometer, with the modification suggested by Prof. Cantoni.

14.—*Condensation.*—This should be observed in all its forms.

15.—*Dew.*—The Conference thinks that observations are important, but for the present, in the absence of a thoroughly satisfactory apparatus, all that is required is the careful entry of each occurrence of dew. It is recommended to conduct investigations for the purpose of devising a satisfactory dew-gauge.

As to fogs, the general rules proposed by the Vienna Meteorological Congress in 1873 should be followed.

16.—*Rain.*—The observations for agricultural meteorological objects should be conducted on the principles laid down by the Vienna Congress.

It is very important for the purposes of agricultural meteorology that as large a number as possible of stations of the lowest order should be established, at which observations only of thunderstorms and of rain should be taken.

17.—For the measurement of snow, gauges should be employed which will prevent the snow being blown out of the receivers.

18.—Observations on the percolation and evaporation of the water in the soil should be introduced into the system of observations in connection with agricultural meteorology, but on no account are lysimeters to be employed. (The methods most recently employed by Prof. Ebermayer in Bavaria have been described by him in an Appendix to the Report.)

19.—Observations on the direction and force of wind should be conducted in the same way as at the ordinary meteorological stations.

20.—In order to investigate the climatic features by which masses of vegetation, such as wood, pasture, moorland and heath, are distinguished, on the one hand from each other, and on the other hand from bare earth, it is desirable to develop further the system of parallel stations, such as were originally established in Bavaria, and subsequently in other States of Germany and in Switzerland. It is also recommended to institute at the forest station of each such pair of parallel stations a new series of observations on the amount of water running down the tree stems.

21.—It is advisable to organise the system of radial stations, in order to ascertain the effect extensive masses of vegetation, especially forests, exert on the climate of the surrounding region both in their immediate vicinity and at a distance.

This system promises better results the more continental is the character of the region in which it is established. In Central Europe, therefore, Eastern Germany comes first, then the Austrian Empire.

When any new stations are established, especially radial stations, observations on the temperature and humidity immediately *above the tree crown* appear to be of great importance.

Question III.

"To what extent, and how, can meteorological observatories and stations include such observations in the sphere of their operations, without hindrance to their activity in other directions?"

22.—In consideration of the requirements of agricultural meteorology which have been already enumerated, the Conference is of opinion that, at least in the larger States, and where distinct organisations for the purpose do not exist, central institutions of a special character should be established. The objects of such institutions should be to perfect the methods of observation, which are as yet in many respects incomplete; to establish subordinate stations, or initiate their foundation; to support private individuals or societies in the foundation and management of such stations; to control their operations, and to collect and discuss their observations.

Such special institutions should, however, always remain in connection with the general meteorological organisation of the country in regard to the critical selection of methods of observation and of the publications.

Question IV.

"Would it not be desirable, with a view to the special observations which must be undertaken, (as *e.g.* Phenological Observations,) to prepare a general form of Instructions?"

23.—The Conference thinks it advisable to entrust to a special small committee, of three members, the preparation of General Instructions for Phenological Observations. This must be preceded by a careful examination and sifting of the Instructions already existing in most countries. The business of this committee should be conducted by correspondence, and care should be taken that the observations do not embrace too long a list of plants. They should deal in the first instance with cereals and forage plants; secondly, with the more important forest and fruit trees; and lastly, with other plants of importance to agriculture, and to the phenomena of animal life.

QUESTION V.

"Can Meteorological Institutes at present issue weather forecasts for the use of agriculturists with any prospect of success? And if the answer should be in the affirmative, how should the service be organised so as to attain this object as fully as possible?"

24.—The Conference is of opinion that, notwithstanding the existing difficulties of the subject, no meteorological organisation can decline to meet the demand of the public for weather forecasts.

25.—The Conference recommends the representatives of meteorology in different countries to prepare popular explanations of the principles on which the forecasts are framed, for the instruction of agriculturists.

(Signed) LORENZ, *President.*
OSNAGHI, *Secretary.*

APPENDIX IV.

LIST OF BOOKS PURCHASED.

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ARCHIBALD, E. D., M.A., F.M.S.—The Cycle of Sun-spots and of Rainfall in Southern India.

BARHAM, DR. C., F.M.S.—Note on some Relations in Land and Sea Temperature in the South-West of England.

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BELL, H.—The true Cause of Rain, a new theory.

BEZOLD, W. VON.—Atmosphärisch-Optische Erscheinungen im Hochgebirge.—Ueber das doppelte Maximum in der Häufigkeit der Gewitter während der Sommermonate.

BLANFORD, H. F., F.R.S.—Note on some large Hailstones.—On the High Atmospheric Pressure of 1876-78 in Asia and Australia in relation to the Sun-spot Cycle.—The Indian Monsoon Rains.

BLOMEFIELD, REV. L., M.A.—The Winter of 1878-9 in Bath, and Seasons following.

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CORDEAUX, J.—Report on the Migration of Birds in the Autumn of 1879.

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DOYLE, P., F.M.S.—Petroleum, and its distillate, Kerosene.

DUNLOP, W. H., F.M.S.—Abstract of Meteorological Observations for 1879.—Rainfall during 1878 at Annanhill, Kilmarnock.—Results of Meteorological Observations made at Annanhill, Kilmarnock, Sept. 1879 to Nov. 1880.

EATON, H. S., M.A., F.M.S.—Report of the Government Meteorological Observer for Queensland, 1878.

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FOX, W. L., F.M.S.—Meteorology of West Cornwall and Scilly, 1870-79.

GALTON, CAPT. D., F.R.S.—On some preventible causes of impurity of London Air.

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GLYDE, E. E., F.M.S.—Abstract of Meteorological Observations made at Babbacombe during 1879.

GORDON, R., F.M.S.—Report on the Irrawaddy River, Parts I. to IV.

GOSLIN, S. B., F.M.S.—The Relative Advantages of Wind, Water and Steam as motive powers, compared with each other.

GREAVES, C., F.M.S.—Account of the Arctic Regions, by W. Scoresby, jun.—Journal of the Royal Agricultural Society, 1840-74.—Lauder's Moray Floods.—Memoirs of the Literary and Philosophical Society of Manchester, Vols. I. to IV.—Proceedings of the Meteorological Society of Mauritius, 1866.—Rainfall in Jamaica during 1877 and 1878.—Summary of Meteorological Observations at Broomhall Park, Sheffield, 1861-67.

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HANN, Dr. J.—Untersuchungen über die Regenverhältnisse von Oesterreich-Ungarn. Parts I. and II.

HELLMAN, DR. G.—Der zweite internationale Meteorologencongress, abgehalten zu Rom im April 1879.—Die Organisation des meteorologischen Dienstes in den Hauptstaaten Europa's, Part II.—Plan für ein meteorologisches Beobachtungsnetz im Dienste der Landwirthschaft des K. Preussen.—Prüfung eines verbesserten Azimutal-compasses und des compensirten Magnetometers Weber-Kohlrausch.

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HOSKINS, Dr. S. E., F.R.S.—Meteorological Observations, Guernsey, Sept. 1879 to Oct. 1880.

LAKE, DR. W. C., F.M.S.—Fourth Report of the Committee on the Meteorology of Devonshire.

LANCASTER, A.—Discussion des Observations d'Orages faites en Belgique pendant l'année 1878, suivie des notes pour servir à l'Etude Générale des Orages.—Notes Météorologiques.

LANCETTA, Prof. P.—Pluviopolverometro, Nuovo ápparecchio meteorologico per la Pioggia e par le Polveri atmospheriche.

LATHAM, B., F.M.S.—Report of the Judges appointed by the Royal Agricultural Society to adjudicate the Prizes in the Sewage Farm Competition, 1879.

LAUGHTON, J. K., M.A., F.M.S.—Paper on Time-reckoning and the selection of a prime meridian to be common to all nations, by S. Fleming.—The Law of Storms and the Heaving-to Tack.

LEWIS, E. W.—Lectures on the Geology of Leighton Buzzard and its neighbourhood.

LOOMIS, PROF. E.—Contributions to Meteorology:—Twelfth and Thirteenth Papers.

MARRIOTT, W., F.M.S.—Reduction of Meteorological Observations.—Remarks on the Winter of 1878-79.

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POEY, PROF. A.— Comment on observe les Nuages pour prévoir le temps.

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ROTH, H. L., F.M.S.—Report on the Sugar Industry in Queensland.

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SLADE, F., F.M.S.—Meteorological Observations taken at Barrow-in-Furness, 1877 and 1878.

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SYMONS, G. J., F.R.S.—British Rainfall, 1879.—Scientific Opinion, Vols. I.-III.—Symons's Monthly Meteorological Magazine, Oct. 1879 to Dec. 1880.—General View of the Agriculture of the County of Devon, by C. Vancouver.—Journal of a Voyage to the Northern Whale Fishery, by W. Scoresby, jun.—Hydrographic Notice, Labrador, North-East Coast.—Hastings and St. Leonard's-on-Sea, their Meteorology and Climate, by J. C. Savery.—Meteorological facts relating to Hastings and St. Leonard's, observed in 1859-62, by J. C. Savery.—The Hastings and St. Leonard's Pamphlet, by J. C. Savery.—Lightning Rods, and how to construct them, by J. Phin.—Manchester, Sheffield and Lincolnshire Railway, Monthly Statement of Rainfall, 1879.—Mémoire sur les diverses espèces de brouillards, par A. Peltier.—Meteorological Observations, Hobart Town, 1879.—Also many other Books and Pamphlets.

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TRIPE, DR. J. W., F.M.S.—Capt. Franklin's Journey to the Shores of the Polar Sea in the years 1819-22.—Ozone in Relation to Health and Disease, by Dr. H. Day.—Reports on the Sanitary Condition of Scarborough, 1872-77, by Dr. J. W. Taylor.—Reports on the Sanitary Condition of the Hackney District, 1876-78.—Also many Medical Officers' of Health Reports.

TROMHOLT, S.—Iagttagelser over Nordlys anstillede i Norge, Sverige og Danmark.

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TYRER, R., F.M.S.—Meteorology of Cheltenham, 1879.

WALLIS, H. S., F.M.S.—Rain collected from roofs considered as a Domestic Supply.

WHITLEY, N., F.M.S.—The Climate of the South of England in the Agriqultural Year 1878-9, and its effects on the Crops.

WHITMORE, DR. J. (late)—Health and Meteorology of Marylebone, Aug. 1879 to Feb. 1880.

WRAGGE, C. L., F.M.S.—On the Summer of 1879 in the Vicinity of the Staffordshire Moorlands (M.S.).—The Climatology of the Churnet Valley.

APPENDIX VI.

Reports of Observatories, &c.

The Meteorological Office. Prof. H. J. S. Smith, D.C.L., F.R.S., Chairman of Council; Robert H. Scott, M.A., F.R.S., Secretary.

Marine Meteorology.—In this, as in the previous year, the staff has been mainly occupied with the discussion, now nearly completed, of the meteorology of the region lying near the Cape of Good Hope. The material contained in the office logs has been supplemented by a series of observations for the district lying south of the parallel of 40° S, which have been obtained from the Meteorological Institute of Utrecht.

In the last Report of the Society it was stated that the results of this discussion would be presented to the public in the form of Charts. Of these there will be two series, one being devoted to Wind, Barometric Pressure, and Air Temperature; the other to Currents and Sea-surface Temperature.

Each series consists of twelve monthly charts, and is accompanied by a key chart showing the twelve charts on a reduced scale.

The wind charts exhibit graphically the relative frequency of the different winds for each point of the compass, the proportion of these winds which blew with the force of a gale, and in addition the mean force of all winds which did not amount to a gale. The general direction of the atmospheric circulation is shown by arrows.

In the wind charts the Council have adopted (as explained in their Report for 1879, p. 8) "the principle of *natural areas*, that is to say, they have treated districts characterised by the same general conditions as wholes, and have abandoned the plan hitherto pursued of dealing with areas bounded by lines of latitude and longitude over which the same meteorological conditions might not prevail. They have also introduced an important correction into the wind data before summarising them, in order to avoid a source of error which has long been pointed out, and which they found to have considerable influence on the results in the Cape squares. This error is due to the over-estimation of the frequency of adverse winds; such winds keeping ships for a long time in nearly the same position, and being thus more frequently recorded than favourable winds. The tracks of outward and homeward bound ships through the Cape squares are different, and consequently if every observation were retained, the frequency of unfavourable winds would in each case be greater than it should be."

The results obtained by this new method of treatment of the data appear to be satisfactory.

The principle of *natural areas* has also been adopted by Prof. Buys Ballot in his Maandelijksche Windkaarten van den Noord-Atlantischen Oceaan, which appeared in 1878, but the areas in that volume are not defined in the same way as those in the charts under consideration.

The pressure is dealt with by diagrams exhibiting the barometric range as well as the mean values.

The air temperature is shown by isotherms for every 2° Fahr.

The current charts show, by means of arrows of proportionate length, the actual currents in miles per 24 hours which have been experienced by all ships traversing the district, the general prevailing currents being indicated by arrows of a larger size.

The temperature of the sea surface is given by isotherms drawn (like the air isotherms) for every 2° Fahr. The localities in which wide differences in the sea temperature have been observed are specially indicated.

Information upon other matters relating to the district, such as, for example, the specific gravity of the sea-water, and the occurrence of ice, will also be placed on the charts, or included in the letterpress accompanying them.

The charts are now in the press, and will shortly appear.

The staff of the office has been increased by the appointment of Nav.-Lieut. C. W. Baillie, R.N., as Assistant in the Marine Department. Mr. Baillie has been engaged in the preparation of sea surface temperature and current charts for the oceans of the globe, and for the four cardinal months (as far as sea temperature is concerned), February, May, August and November. The charts

for the Pacific are completed, and those for the Indian Ocean are in a state of forwardness.

The second part of the contributions to our knowledge of the meteorology of the Arctic Regions (a volume of 212 pages) has been published. It refers to a number of expeditions wintering in the Arctic Regions, of which a list is given in the Report of the Office for 1880, which has just appeared. A third part is in preparation, containing a *resumé* of the observations of every other British expedition wintering within the district under treatment. With these will be combined the data from the four United States expeditions to the same region, those of De Haven, Hayes, Kane, and Hall.

The Council have undertaken an inquiry into the sea surface temperature round the coasts of the United Kingdom with the kind co-operation of the Admiral-Superintendent of Naval Reserves, the Brethren of the Trinity House, and the Commissioners of Irish Lights. The points of observation, fifty in number, are partly coastguard stations, partly lightships. The observations have now been continued for the space of eighteen months.

Weather Telegraphy.—A new station has been established during the year at Barrow-in Furness by the liberality of the Furness Railway Company, who provide for it at their own cost.

The subject of the maintenance of an evening telegraphic service, at the expense and for the exclusive benefit of the three subscribing newspapers, the 'Times,' 'Standard' and 'Daily News,' was brought before Parliament in the summer, and, by instructions from the Treasury, the subscription for the evening forecasts was reduced on July 1st from £300 to £25 per annum as a tentative measure, in order to render the information more generally accessible. At the close of the year the Government resolved that the evening forecasts should be issued gratis to all newspapers; and have increased the grant to the Office in order to meet the cost of the service. This change was introduced on January 1st, and there are now over 100 newspapers regularly supplied with forecasts for their respective morning issues.

Simultaneously with this change a material alteration in the form of the lithograph Daily Weather Report was introduced. The sea portion of the chart is printed in blue, with a view to greater distinctness, as in the 'Bulletin International,' and the monthly mean values of pressure, temperature and rainfall are given on the charts, so that the variations of the actual reading for each day from their average values for the month can be seen.

The number of daily charts also is reduced from four to two, while their size has been increased.

The results of the forecasts up to April 1880, as regards their success or the contrary, were forwarded to the Society in July, and included in a letter addressed by it to the International Conference for Agricultural Meteorology held at Vienna in September.

The work prepared by the Rev. W. Clement Ley to replace one of the sections of the old Barometer Manual of the Board of Trade, has appeared under the title of 'Aids to the Study and Forecast of Weather.' As an evidence of the usefulness of this work, it may be mentioned that (as appears from the 'Revue Maritime et Coloniale') it is now officially supplied (in translation) to every ship in the French Navy.

The Weekly Weather Report has been improved by the addition of columns showing the means of the daily maximum and minimum temperatures, and the duration of bright sunshine, as recorded at about thirty stations.

Land Meteorology of the British Isles.—The results from stations of the second order for 1878 have been published, and form a volume of 177 pages. The volume for 1879 is in the press.

The lithographed hourly values of the measurements of the continuous curves at the seven observatories have been issued up to the end of 1879.

The Plates for the Quarterly Weather Report for 1879 are complete, those for 1876 and for 1880 are in an advanced state. The text of Part I. for 1876 is nearly ready for issue; this will be materially different from the previous volumes, it will contain tables of all the important depressions which have visited the United Kingdom during the quarter, monthly mean results for all the stations of which the data are published by the Meteorological Office, and a series of index charts, two for each day, intended to show at a glance the sequence of weather during the whole of the quarter.

The principal appendices to the Part will consist (1) of a comparison of the continuous records at Kew and Greenwich for the year 1875, and (2) of the results of the experiments on temperature and humidity at different heights up to 126 feet above the ground, which were carried on at the Pagoda in the Royal Gardens, Kew, in the years 1872-4.

The first of these investigations, as explained in the Report of the Meteorological Council for 1879, was undertaken "with a view of ascertaining to what extent the more minute variations in the curves of self-recording instruments might be due to local causes, and to what extent they might express meteorological conditions of a more general character." The curves have been reduced to the same scale, and are exhibited side by side on 25 plates, each of which, except the last, contains the records of 15 days.

The Harmonic Analyser has been carefully tested during the year and its performance has been found to be very satisfactory, although the necessarily limited scale of the photographic curves has presented some difficulty in the way of following the trace accurately with the pointer.

The Report of the Office contains an important memorandum by Prof. Stokes on the capabilities and intended use of the instrument.—*April 1st*, 1881.

ROYAL OBSERVATORY, GREENWICH. Sir G. B. Airy, K.C.B., F.R.S., Astronomer Royal.—No fundamental change has been made in the meteorological work of the Magnetical and Meteorological Department during the year 1880.

During the autumn of 1879 it was discovered that the pressure plate and other parts of the pressure apparatus of Osler's Anemometer were so much worn as to require renewal. But, although preparations were made in November 1879, for taking down the apparatus, unfavourable weather prevented this being done until the early part of the year 1880.

The pressure apparatus was then in all parts thoroughly restored, opportunity being at the same time taken to increase the range of the scale, so that a pressure of 50 lbs. on the square foot might be registered. This amount of pressure has since been once reached, in the severe gale and snow storm of January 18th, 1881. The pressure plate now exposes a surface of 192 square inches, instead of 288 as before.

The observations of the temperature of the water of the Thames, carried on for so many years, have for the present terminated. The police ship 'Royalist,' after repair, was not again moored in the river, but was placed high on the river bank, in such a position that the observations could not be continued.

The annual volume for 1878 was published during the course of the year, and the printing of that for 1879 is nearly complete; in the latter will be found results in regard to atmospheric electricity, deduced from the photographic records of Thomson's electrometer.—*Feb. 7th*, 1881.

ROYAL OBSERVATORY, EDINBURGH. Professor C. Piazzi Smyth, F.R.S.E., Astronomer Royal for Scotland.—During the past year the bi-diurnal observations at 55 stations of the Scottish Meteorological Society have been computed and discussed for the Registrar-General of Births, Deaths, &c. in Scotland, and printed by that officer in his monthly and quarterly returns. The occasion, too, was more than ordinarily interesting on account of 1880 being the year announced at the Edinburgh Observatory many years ago (on the strength of the cyclical connection already made out there between sun-spots and earth-temperatures), as due, or expected, to be the warmest year for eleven years; especially in that part of the year 1880·6 and 1880·8. And so it proved; for both August and September of 1880 were warmer than those months had ever been chronicled before in other years. And if the nearest approaches to anything so high occurred in 1868, 1857 and 1846, those were similar marked years of the Edinburgh Observatory, with reference to the sun-spot cycle.

Whether the sun at these epochs either actually makes more heat, *i.e.* becomes hotter in itself, or with a constant rate of local heat-production, lets it escape by radiation into space more easily by just then thinning his generally existing and very absorptive external atmosphere; or whether, again, the undoubted eleven-year wave of extra-temperature actually experienced in the earth at Edinburgh,

and proved to have come from without, be after all—at least in its major part—chiefly owing to the clearing away of terrestrial clouds in northern latitudes in those years, and so giving the Hyperboreans the warmth of sunshine *versus* the cold shade of mist, while winds carry away the heat reflected by the upper cloud surface to other parts of the earth—all that is a matter which should next be deeply inquired into; but the Royal Observatory, Edinburgh, being kept in a starving condition by London officials, has no means for the purpose; and leaves the inquiry to better supported institutions in the South.—*Jan. 4th*, 1881.

KEW OBSERVATORY. G. M. Whipple, B.Sc., F.R.A.S., Superintendent.—The several self-recording instruments for the continuous registration respectively of atmospheric pressure, temperature, humidity, wind (direction and velocity), and rain have been maintained in regular operation throughout the year. The standard eye observations made five times daily, for the control of the automatic records, have been duly registered through the year, together with the additional daily observations at 0.45 p.m. in connection with the Washington synchronous system, and at 6.45 p.m., for the second synchronous system organised by M. Mascart, Directeur du Bureau Central Météorologique, Paris.

The tabulation of the meteorological traces has been regularly carried on, and copies of these, as well as of the eye observations, with notes of weather, cloud, and sunshine have been transmitted weekly to the Meteorological Office.

With the concurrence of the Meteorological Council, weekly abstracts of the meteorological results have been regularly forwarded to and published by 'The Times,' 'The Illustrated London News,' and 'The Torquay Directory.'

The Electrograph has been in continuous action through the year. During the severe frost of last winter it was found necessary to heat the water flowing through the discharge pipe by means of a spirit lamp, suspended from the collector. This precaution enabled the records to be maintained throughout the year, with very few interruptions due to frost.

Some experiments have been made with a view of determining the effect of the interposition of an air condenser between the collector and the electrometer, in reducing the extent and rapidity of the electrical changes registered by the instrument under certain atmospheric conditions. These experiments are still in progress.

No steps have yet been taken as to the discussion of the seven years' curves now in store, but suggestions as to the means of dealing with them are under consideration.

The Campbell sunshine recorder continues in action, and the improved form of the instrument, giving a separate record for every day of the duration of sunshine, has been regularly worked throughout the year, and its curves tabulated. In April last, the new pattern of card-holder, devised by Professor Stokes, was substituted for that previously employed, in order that the records produced by the instrument might be in conformity with those obtained from the other stations of the Meteorological Council. Since that date both cards and tabulations have been transmitted regularly to the Meteorological Office, copies, however, being retained in the Observatory for reference.

Winstanley's Recording Radiograph, for the purpose of registering continuously the amount of radiation from the sky, by mechanical means, upon a sheet of blackened paper, has been erected on the roof of the Observatory since the beginning of August. Its indications, which were procured for some weeks, showed it to be a much more delicate appliance than the sunshine recorder or the black bulb thermometer, being affected by changes of radiation from the sky, which take place both at night and when the sky is clouded, as well as when the sun is shining. No use has, however, yet been made of its curves, mainly on account of the difficulty of determining a scale value for them.

Experiments have been continued throughout the year with the view of determining the relative merits of different patterns of thermometer screens.

The Glycerine Barometer has been in successful operation, and, in compliance with the request of the inventor, has been continuously observed in conjunction with the mercurial barometer five times daily. Its value as an instrument of precision cannot be determined until the observations now in process of reduction by Mr. Jordan have been completed. Meanwhile the Committee have

decided to continue the periodical readings, and to make several separate series of readings, at frequent intervals, during periods of atmospheric disturbance, so as to determine its relative degree of sensibility as compared with ordinary mercurial instruments.

Various experiments have been made with several forms of nephoscope, and also with a new cloud-camera, designed by the superintendent.

The indications of the two De la Rue evaporation gauges were noted every day, at 10 a.m., together with those of a Piche Evaporimètre, until the end of July, when, at the request of the Meteorological Council, they were transferred to the care of Mr. Shaw, who is at present engaged at Cambridge in an experimental investigation on hygrometry.

There has been a satisfactory increase in the number of meteorological instruments verified, which was as follows :—Barometers 224, Thermometers 5,344, Various 46.

The Winchester Observatory of the Yale College, U.S.A., having recently established a department on the Kew system, for the verification of thermometers, Professor Newton, Secretary of the Institution, visited the Observatory, studied the methods employed for comparing thermometers, and procured copies of the various forms and certificates used in the work.

Numerous comparisons have been made between the two Welsh Standard Barometers, the old Royal Society Standard (which it is found cannot without risk of derangement be returned to Burlington House), and Newman 34, the working Standard of the Observatory. Arrangements have been made by means of which the latter may, when desired, be read by the cathetometer, as well as by its own scale, the correct value of which has also been re-determined.

The Kew Committee, having memorialised the Under Secretary of State for the Colonies with reference to the establishment of an Observatory for magnetical and meteorological purposes at Hong Kong, has been gratified by the receipt of an announcement to the effect that the Governor of Hong Kong has been authorised to propose a vote for the establishment of an Observatory in that colony.—*Jan. 5th*, 1881.

Radcliffe Observatory, Oxford. E. J. Stone, M.A., F.R.S., Radcliffe Observer.—The results of the eye observations made during the years 1876, 1877, 1878 and 1879 have been discussed and published in a single volume. The photographic observations made during these years are incomplete, and it is doubtful whether they would now repay the labour and cost of tabulation and discussion. A new set of photographic instruments, a Beckley's anemometer, a self-registering rain-gauge, and a sunshine recorder, which have been kindly lent by the Meteorological Council, were mounted and brought into satisfactory use in February 1880. The results are now being tabulated and discussed.

Observations are regularly made for and forwarded to the Meteorological Office, London, and the Chief Signal Office, War Department, Washington, U.S.A.

The readings of the instruments at 8 a.m. are posted at the Observatory gate for public use, and appear from the attention which they attract to meet a want. —*Jan. 5th*, 1881.

Stonyhurst Observatory. Rev. S. J. Perry, M.A., F.R.S.—An important addition was made on March 25th to the meteorological instruments previously in use at the Observatory, a sunshine recorder having been erected near the SE side of the main building. Daily solar observations of the chromosphere have been continued on every available opportunity, but it not unfrequently happens that the state of the sky renders all accurate measures of the chromosphere impossible, even though the sun may be shining strongly enough to burn the cardboard of the recorder. A special assistant has been employed since September in the solar observations.

The meteorological results, obtained by the self-recording and other instruments, have been forwarded as usual to the Meteorological Office, and portions of them have also been sent to the Registrar-General, to the editor of the Meteorological Magazine, to the French Meteorological Society, to the United States

Meteorological Office, to the Upsala Observatory, and to several gentlemen in connection with the water companies of the neighbouring towns.

The annual testing of all the thermometers in use showed this year that the corrections throughout are invariable.

Copies of some of the magnetic curves have been sent to Kew for comparison with those of continental and colonial observatories. The reductions of the horizontal curves of the last twelve years are almost ready for publication.

A change of assistants, due to very serious illness, has greatly retarded the extra work at the observatory.

In the course of the year the Director has despatched a large automatic spectroscope to the new observatory at Kalosca, and a Thomson electrometer to Zi Ka Wei. Four magnetic needles, and a thermometer for the unifilar magnetometer, are at present being constructed for Manila.—*Jan. 12th*, 1881.

"Relative Humidity." By Charles Greaves, M.Inst.C.E., F.G.S., F.M.S. (A Letter addressed to the Council.)

[Read February 16th, 1881.]

The misuse and misunderstood use of the words "Relative Humidity," so much and so frequently employed in all meteorological research, essentially so in all hygrometric studies, is so extended that I am emboldened to lay before the Council some remarks with a view either of the disuse of the expression as a heading, and dropping the use and computation of the values altogether, or of causing other tables of value to appear, which being correct in showing what is generally falsely attributed to, and understood as, Relative Humidity, would correct that false assumption, would supply the real values which are looked for by students, and would place relative humidity in its proper position and with its true and exact meaning.

I may almost say, that no one need be told that air or the atmosphere at every temperature has its own absolute humidity of saturation, and although tables of the moisture in grains which give the saturation at all temperatures are not put forward as freely as they should be, yet, I think, no one versed at all in the subject is ignorant that the warmer the air is, the more moisture it is able to take up or acquire before it reaches saturation. Now the proportion which the quantity of moisture that air at any temperature at any time contains, bears to the quantity it would contain, if saturated, is the relative humidity of that air, but this relative humidity is no expression of *comparative* humidity, and yet it is constantly a subject of misapplication, for it is used, in a sense identical with quantity or degree, in simple comparison.

There is scarcely an author or a writer who does not always drop all reference to the matter relative to which the word "relative" is intended to carry the mind; but even the word relative itself, is continually dropped, and relative humidity is called simply "humidity." The error thus proceeds to those imperfectly versed in the matter, and the expression relative humidity, and humidity relatively valued, are adopted into the place and meaning of comparative humidity.

Now, the summer season gives an air in which the proportional or comparative quantity of moisture present, is greater than in winter; this is a well known and absolute fact; the summer air is moister than the cold winter air. The summer season, however, gives an air in which the saturation is less complete, full saturation being further off; in other words, the relative humidity has a lower value. The relative humidity table is consequently completely inverted, and the period or season of maximum moisture is at the bottom of the scale, and that of minimum moisture at the top. In all such series of tables as give the "tension of vapour," or "weight of vapour in a cubic foot," or "dew-point," or "mean temperature," or even "the weight required to complete saturation," there is sufficient visible to keep a student from taking the relative humidity column for a guide; but when it appears alone the relative humidity column is taken innocently to mean the proportionate, or comparative humidity, and adopted accordingly. Now, an expression of comparative humidity is really what everybody looks for. It is one of the salient points in a simple conception of the state of the weather, as much so as the degree of heat, or the value of barometric pressure.

Unfortunately our tables of relative humidity so frequently stand alone that there is nothing to suggest even a doubt that the values given are not values of comparative or proportionate humidity, and so of simple humidity; and thus we find people passing on incessantly to a false conception of the moisture of the air from an inspection of its relative humidity. It is true that if the air were always at one temperature, the relative humidity would be an inverse scale of true proportionate humidity; but it is only under that condition, which is obviously non-existent, that it could be so. Every temperature has its own maximum of moisture, called very properly "saturation;" all hygrometry depends on this, but the degree of saturation of cold air (which takes less to saturate it) will always, and must always, run equal and parallel with the same degree of relative humidity in warmer air, which will contain before it is saturated, and contains a far larger degree of actual moisture in it at the same relative humidity. The extent to which the error goes is ludicrous; book after book is printed with tables of relative humidity, but no correcting values under another head stand to correct them or supplement the deficiency; and the registers and returns from distant and very different countries, are valued against one another, for dryness, on a table of relative humidity, which in reality only gives the approach towards saturation at the temperatures stated, of course, elsewhere in the same tables.

Some one has said that, although the relative humidity table is an inverted one, it is possible to invert it as you go, and see it in a correct light; but why make it wrong—wrong, at least, for all the purposes for which the rapidly increasing number of students require and study it?

Comparison of Vapour Tension and Relative Humidity for Seven Years, 1873-79, at the Royal Observatory, Greenwich.

Years.	Vapour Tension.		Relative Humidity.	
	Winter. January.	Summer. July.	Winter. January.	Summer. July.
	In.	In.	o/o	o/o
1873	·231	·431	87	74
1874	·228	·427	87	70
1875	·230	·412	81	83
1876	·189	·442	85	69
1877	·236	·394	86	74
1878	·212	·430	84	75
1879	·146	·409	80	84
Means	·210	·420	84	75

Average moisture in a cubic foot of air for the same period is—

January ..... 2·428 grains.
July ..... 4·700 ,,

By this illustration of January and July, does it not appear that while January has 2·428 grains of moisture in a cubic foot of air, with a corresponding relative humidity of 84 per cent., the July moisture is 4·700 grains per cubic foot with a corresponding equal relative humidity of 75 per cent. ?

The two humidity values are not, therefore, expressive of any simple comparable quantity, and although 84 per cent. stands as corresponding to a winter, or a minimum, amount of moisture, the summer value of 75 per cent. of a higher saturation quality represents twice as much moisture as the 84 per cent. expressed by the winter, or lower, saturation value.

The average vapour tensions are, for January, ·210 in., and for July ·420 in.; this is real proportionate humidity. The average relative humidity—that is relation of humidity to saturation—of January, is 84 per cent., and of July is 75 per cent. (saturation being 100)—*i.e.* in January the air has 84 per cent. of saturation, and in July the air has 75 per cent. of saturation. If, then, these latter are looked at for a moment as evidence of proportionate moisture, the conclusion is all astray, inverted and inverse; and although the figures are absolutely right in themselves, misapplication makes them a source of endless error.

It will appear a conceited and invidious remark to say that the members of the International Meteorological Congress at Vienna did not understand what they were about when they decided upon the use of the Relative Humidity.

The use of a relative humidity table without a real comparative humidity is a rank absurdity. The relative humidity absolutely teaches nothing, and if it has any *simple* meaning at all, it is that the stations referred to are in the inverse order of the figures denoting relative humidity, warmer one than the other. It does not give their condition as to comparative humidity at all, but only their relative conditions of saturation at the temperatures severally named.

As long as the Society's tables contained the column "tension of vapour," they had a comparative expression for vapour suitable for all hours at the same place, and all places; and the relative humidity was by this under control as to its appropriate use by having a real and true comparative humidity table close to it. The fact is that the scale of relative humidity is no scale of comparative humidity, or even humidity at all; it is a scale of the degree of saturation, not of humidity; it is a scale of the proportion in the progress towards saturation at its given stated temperatures enjoyed by any air, of which the temperature is named. The proportion towards saturation is not a proportion of humidity, because every imaginable temperature has a different degree of saturation.

The degree of moisture—the true comparative state of moisture—is the question or thing always sought, and of this the relative humidity gives no information whatever. However, after all, it may be more useful to blame the expression and not the people who use it. The expression relative humidity is bad altogether, it should have been the relation of humidity. No doubt the words relative humidity have arisen from the desire for a concise form of expression—in truth they are descriptive of the *relation* of the humidity, and not of the actual humidity, and consequently it moves from 0 to 100, being an indication of the scale of relation to saturation, which is its consummation. Just in the same way the relation of a man's appetite to food is one of satiety complete or prospective, not usually expressed as a percentage, but satiety is the relation of the appetite to the food, not the food itself. Hunger also faint and furious is the same, but here the scale has its zero at the other end; and, indeed, for that matter, if our relative humidity curve had been one of the complements it would have had its zero at the other end and have been turned the right way, whereas it is now a reverse curve, expressive of a relation only, not of a fact or of the magnitude of matter.

As I said before, if there were one universal temperature, relative humidity would give a scale of moisture in air still inverse. In reality it is only a scale from a moveable zero or base, which zero or base requires another element to be stated, viz. temperature, and this having been stated the maximum of saturation would be known and the proportion from 0 towards 100 in saturation would be declared.

I consider the misunderstood use of relative humidity has been the most fatal misapplication of industry possible, and has wearied and confused the whole study of hygrometry almost beyond recovery. Even combined with a true scale it is useless, for it leads to nothing, and without an accompanying true scale it is pernicious to the last degree, for it surreptitiously takes the place of the true scale, a matter which must be a principal object of our research.

DISCUSSION.

Mr. LAUGHTON, in a note to the PRESIDENT, said:—"Although I can quite understand that tables of relative humidity may sometimes be misleading to those who do not fully consider the meaning of them, I am not prepared to join

Mr. Greaves in his absolute denunciation of them. They have their use; and no one column can be devised which will satisfy every possible want, or to which no objection can be made. Mr. Greaves proposes dryness, or the depression of the dew-point, as a substitute. For those who understand what is meant, it seems to me no worse and no better than the other; but it is a change, of the necessity of which I am doubtful. Even after having read Mr. Greaves's paper, I can conceive that humidity may be useful, dryness may be useful, or depression may be useful, always if the terms are rightly understood; but if they convey the idea that the humidity, dryness, or depression is some absolute measurement depending only on itself, the mistake is equally great, whatever term is used. In illustration of what I mean I may refer to the records of the remarkable dryness on the Peak of Teneriffe, described by Mr. Piazzi Smyth in his 'Teneriffe, an Astronomer's Experiment," and more recently by Dr. Marcet, in a paper which he read before the Society, June 18th, 1879. Dr. Marcet records, for instance, that at noon on July 6th, 1878, the dry bulb showed 83° and the wet 53°·5, or a difference of 29°·5; whilst 17 hours later, at 5 a.m. on the 7th, the dry bulb showed 45°·5 and the wet 36°·5, or a difference of only 9°.° Suppose then that these differences were tabled—Would it not seem that there was an extreme difference in the quantity of moisture in the air? If I remember right, after the reading of Dr. Marcet's paper, there was some conversation—not recorded as a discussion, in the Journal—as to the cause of this marked difference. Was there a change of wind? it was asked; evidently there was a difference of vapour supply. But in point of fact, there is no difference worth speaking of; the quantity of vapour in a cubic foot of air, under the two very different conditions, is the same; —about 1·5 gr. at 30 ins. barometric pressure, and less at the reduced pressure of the elevated station. It seems to me that no mere tabulation of dryness, or depression, any more than that of humidity, would serve to check any such false impression, or the theories as to the origin of the vapour-bearing wind which might spring from it. Nothing can do this without the record of temperature; and so long as that is given, whether it is accompanied by the *wet bulb, dew-point, depression, relative humidity*, or *dryness*, should (so far as possible) depend on the particular object which the individual student is aiming at. Any one of them will give all the others, provided (that is) we may accept the theory of the wet bulb as perfect."

Dr. TRIPE said that the term "relative humidity" adequately expressed the meaning it was intended to convey; and that if some people misunderstood it, that was no reason why it should be altered. For his own part, he could tell whether the air was saturated by his own feelings; the effect of the moisture of the air on health being very great. He thought that the Society would be doing a wrong thing to alter the term, and adopt the suggestion of Mr. Greaves, as, in his opinion, it would be a retrograde step to substitute figures which *per se* did not convey the necessary information, but must be supplemented by the mean temperature, or other figures showing the point of saturation for each month.

Mr. GASTER could not agree with Mr. Greaves in the conclusion to which he had come with regard to the term "relative humidity." Some expression is required to indicate what may be termed the *drying power* of the air, and this requirement is satisfied more nearly by relative humidity than by any of the other hygrometrical terms employed. It was quite clear that when he had commenced making his investigations Mr. Greaves had mistaken the meaning of the words, but that is no proof that the words themselves were bad; and it could hardly be desirable that a really useful expression should be "black-balled" because in one or two cases its meaning had not been thoroughly grasped. The fact is that the subject itself is complex, and no mere alteration of the terms used would make it simple.

Mr. ARCHIBALD said that he quite agreed with everything that had been said by the previous speakers, but he thought that though the term "relative humidity" was decidedly unfortunate and liable to misconstruction, he did not think the element it expressed ought, therefore, to be omitted from meteorological registers. In India, for example, the annual variation of relative humidity coincided very closely with that of cloud and rainfall, so that it there very frequently formed a useful index to differences between the climates of places

° Quarterly Journal, Vol. V. p. 231.

where the vapour tensions, and therefore the absolute humidities, being almost identical, afforded no clue whatever. Moreover the term "relative humidity" was the expression of a physical fact, viz. the proximity to saturation of the air at a given moment; so that whatever might happen to the *term*, the *fact* should not be overlooked.

Mr. SCOTT said that he supposed that the term "relative humidity" had originally been taken from Saussure's hygrometer, which was graduated for percentages of humidity.

Mr. MAWLEY thought that the author of the paper had endeavoured to separate two inseparable things—humidity and temperature; for he had held out the hope that some value might yet be found which, standing alone, would express intelligibly and for all purposes that subtile element we termed humidity. He apparently considered that the time had come when a vapour tension column might with advantage be substituted in the place of that at present devoted to relative humidity, although for climatological purposes, at all events, the latter was by far the more intelligible of the two. For instance, in a very cold and humid locality the mean vapour tension would come out about the same as in a hot and extremely dry one, although the air of the former might be nearly always saturated with moisture, while the percentage of relative humidity in that of the latter would be a very low one indeed. He (Mr. Mawley) was of opinion that no other value at present suggested had been shown to have so decided a superiority in point of general usefulness over the one now known, rightly or wrongly, as "relative humidity," as to be entitled to supersede it, and so render all those results useless which have been accumulated, with so much patient industry and during so many years, by observers all over the country.

Mr. WHIPPLE thought that, looking at the fact that meteorological tables are applied not only to climatological and physiological but to scientific investigations, it would be advisable to give, in addition to relative humidity, the number of grains of vapour in a cubic foot of air and also the tension of the vapour.

Mr. RAMSAY remarked that he had met with the same difficulty as Mr. Greaves, but he had overcome it by using the term "evaporative capacity of the air," and expressing such capacity by the number of grains of aqueous vapour per cubic foot the air was still capable of taking up.

Mr. BALDWIN LATHAM quite concurred in the remarks which had been made by Mr. Greaves. The records in the column of relative humidity which appeared in the tables bore no relation to each other, therefore the heading of the table was clearly a misnomer. All meteorological observations which were relative were reduced to one common standard. Relative humidity observations taken at different times and places, being based on different temperatures, were not relative. If vapour tension at every temperature were used as the mode of expressing humidity, it would, when multiplied by 100, represent the percentage of humidity present in air having a standard temperature of 79°·3, and observations so recorded would be relative and would compare one with another. It was a mistake to suppose that the feeling of mugginess in the air was dependent on the percentage of moisture present at any temperature. The fact was that a saturated air at a low temperature did not cause the inconveniences, or the unpleasant sensations, which were experienced with humid air at a high temperature. The sensations of unpleasantness arising from humidity were in proportion to the actual amount of vapour in the air, which was always less at a low temperature than at a high one, although the percentage may be more at a low temperature than at a high temperature.

Mr. FIELD said that the question seemed to divide itself into two parts, 1st, whether the figures given as "relative humidity" were rightly named, and 2nd, whether they were the right elements to give. As regards the first part of the question, he thought that there was no doubt that the figures were wrongly named, and considered that "percentage of saturation" would be a more accurate term. As regards the second part of the question, he was not prepared to give an opinion. He must, however, confirm Mr. Greaves's statement that the so-called "relative humidity" was not what was wanted for evaporation investigations.

Mr. ELLIS said that in the Greenwich observations the term "degree of humidity (saturation = 100)" was employed, and seemed sufficiently clear though rather long. The difficulty arises from the desire to confine the necessary information to one column. If any addition were made he considered that "grains

weight of vapour in a cubic foot of air" would, with the "relative humi give all necessary information.

Mr. STRACHAN said that relative humidity is nothing more than the perc of the vapour tension which could possibly exist under any circumstances any time. Hence, like all percentages, while it gave some information, it dis all the rest. If a person said his property was in the Three per Cents., h no information as to the amount of his income. So when it is said the re humidity is 80, you get no information as to the actual quantity of water di The method of percentages was much abused. A favourite *ruse* is to take of observations and per-cent. them, which means giving the same weight the groups, whether they consist of a large or small number of observ The results of such work must be misleading. He could not deny that sometimes useful, as, for instance, in dealing with the records of sunshine astronomical conditions gave different possible durations of sunshine to di latitudes, it was not fair in all cases to compare the absolute duration at one with that at others; but a reduction to the percentage of possible s rendered comparison easy and certain. Much might be said for and a the use of relative humidity. For his own part he did not greatly to it, but he thought the practice of the Society in its published tables, in relative humidity and suppressing vapour tension, very much to be regretted thought that Mr. Greaves objected to this practice, and so far he was entir accord with him.

The PRESIDENT (Mr. Symons) stated that originally there were two co in the Society's tables, vapour tension and relative humidity, but when the p form of table was adopted there was not enough space on one page for bo the vapour tension column was removed, relative humidity being considere more useful, as it better expressed the effect upon the feelings. As reg sanitary purposes, he considered relative humidity the most useful expres the hygrometric state of the air. He said that evaporation was largely depe upon the amount of wind passing over the evaporating surface.

THE FROST OF JANUARY 1881 OVER THE BRITISH ISLES. By WE MARRIOTT, F.M.S., Assistant Secretary. (Plates VI.-IX.)

[Read February 16th, 1881.]

AT the February Meeting of the Society last year I gave an account o distribution of the frost of December 1879 over the British Isles. I been requested by the Council to discuss in a similar way the severe fr January of the present year. This was remarkable chiefly for its unexp appearance, its long continuance, and its sudden breaking up. A notic feature also was the heavy gale and snowstorm of the 18th, which wr such terrible havoc over the southern part of England.

The first week of January was comparatively mild, but cold weather over the north of Scotland on the 5th.

On the 7th the lowest temperature recorded was 9° at Braemar. Rea below 20° prevailed over the whole of the northern half and the south-e Scotland, and in the counties of Chester, Radnor, Cardigan and Corn while the temperature fell below the freezing point at all the Scottish sta and also at all the English stations, except those on the sea-coast. Rea below 30° also prevailed over the greater part of Ireland.

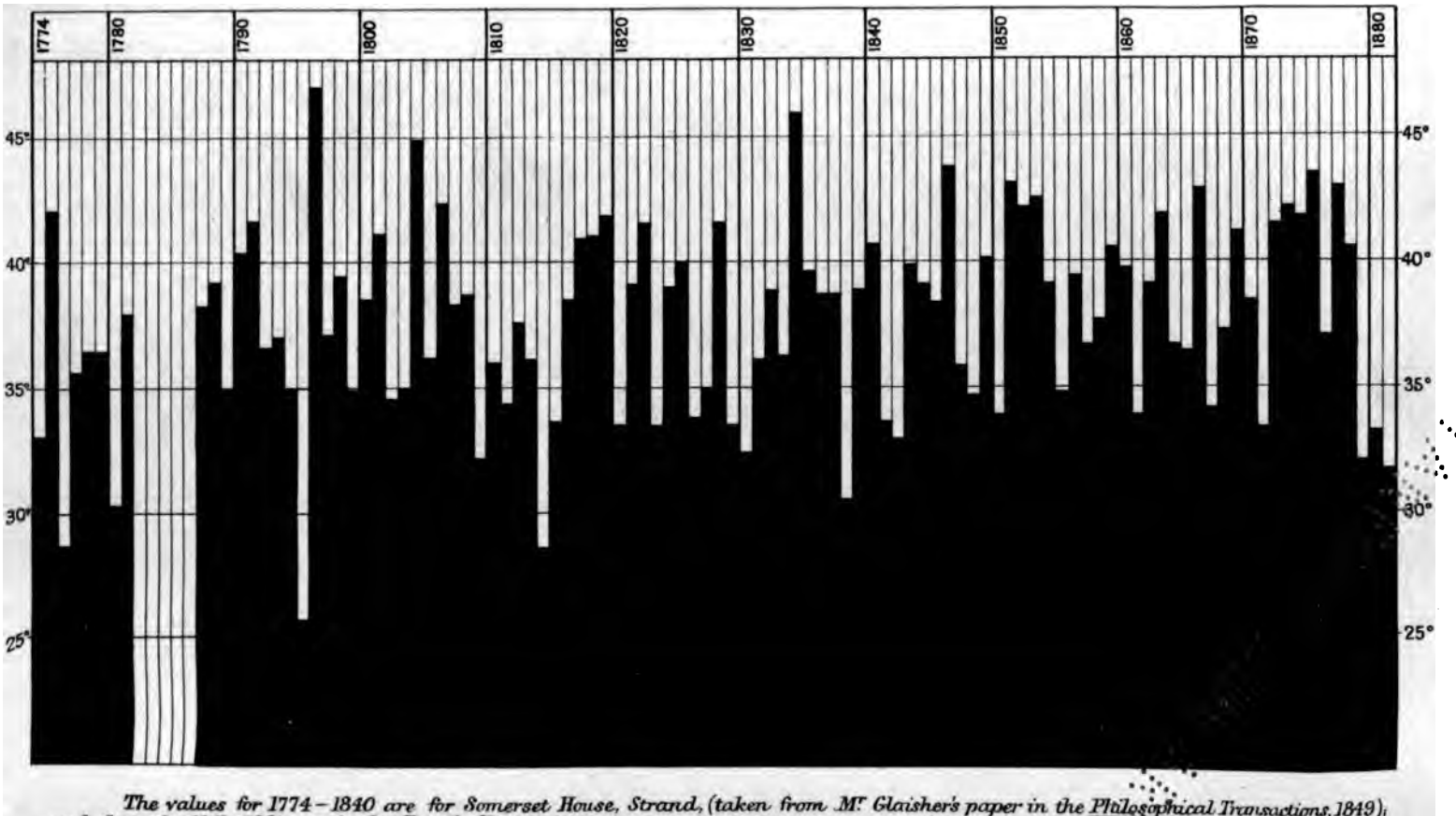
On the 8th the temperature fell to 10° or below it, at Achonachie, Br

Malbry & Reeve, Lith.

MINIMUM TEMP.
JAN. 18.
Shetland Is.
Orkney Is.
Hebrides
SCOTLAND
Aberdeen
BRITISH
ISLANDS
IRELAND
IRISH
SEA
ENGLAND
Belfast
Dublin
Waterford
Cork
Manchester
Liverpool
Carnarvon
Birmingham
LONDON
Dover
Calais
Yarmouth
Newcastle
Portsmouth
Lands End
Scilly Is.
ENGLISH
CHANNEL
Channel Is.
Rouen
MINIMUM TEMP.
JAN. 22.
Wick
Dundee
York

Property of Library

FROM 1774 TO 1881 (EXCEPTING 1782–1786).



The values for 1774–1840 are for Somerset House, Strand, (taken from Mr. Glaisher's paper in the Philosophical Transactions, 1849), and those for 1841–1881 are for the Royal Observatory.

and Drumlanrig, and was below 20° over the whole of the northern, central and southern parts of Scotland, the north-west of England, and the western part of Wales; while temperatures below 32° were registered generally except on the coasts of Yorkshire, Lincolnshire, Norfolk, Kent, Sussex, Devon, Cornwall, and the south and west of Ireland.

On the 9th the temperature fell to 10° or below it, in the central and southern parts of Scotland, and in Merionethshire. Temperatures below 20° were registered over the greater part of Scotland, the north-west of England, the west of Wales, and the central part of Ireland. Readings below the freezing point prevailed all over the United Kingdom, except on the east coast of England, Devon, Cornwall, and the south-west of Ireland.

On the 10th the lowest temperatures registered were 10° at Melrose and Stobo, near Peebles. Temperatures below 20° prevailed over nearly the whole of Scotland, the north-west of England, and the central and north-eastern parts of Ireland. Readings between 20° and 30° prevailed over the whole of the British Isles except the southern part of England and the south coast of Ireland.

On the 11th the temperature fell below 20° over the greater part of Scotland, the extreme north-west of England, and at Macclesfield and Corwen; while over the whole of the United Kingdom the temperature fell below the freezing point, except at a few of the southern sea-coast stations.

On the 12th readings below 10° were registered in the southern parts of Scotland, and in the counties of Northumberland and Lancaster; the lowest being 4° at St. Michael's-on-Wyre, 6° at Alston, 7° at Stobo, 8° at Kelso, Blackpool and Garstang, 9° at Melrose and Lanark, and 10° at Drumlanrig and Wolfelee. Readings below 20° were registered over the greater part of Scotland, England and Wales, and the central part of Ireland; while the temperature fell below the freezing point at all places except Falmouth, Penzance, Scilly, St. Ann's Head, and Holyhead.

On the 13th the lowest readings registered were: —2° at Cardigan, 0° at Braemar, 3° at Markree Castle, 5° at Seaford and Castlewellan, 6° at Stronvar and Stobo, 7° at Alston, 8° at Achonachie, Glenalmond, Drumlanrig, Garstang and St. Michael's-on-Wyre, 9° at Lanark, and 10° at Sandwick, Blackpool and Cheltenham. Readings below 20° prevailed over almost the whole of Scotland, the western half of England, and the greater part of Ireland; while the temperature fell below 30° all over the British Isles except at Holyhead and Scilly, where readings of 30° and 32° respectively were registered.

On the 14th the frost became more intense, readings below zero occurring in several parts of the country. The lowest temperatures registered were: —4° at Corwen, —3° at Cardigan, —1° at Achonachie, Thirlestane Castle, Alston and Ketton, and 0° at Braemar. Readings below 10° prevailed over the greater part of Scotland, the northern, eastern and western parts of England, and the greater part of Wales; and also in the counties of Down and Tipperary in Ireland; while readings below 20° were registered except at some of the extreme sea-coast stations and the west of Ireland.

On the 15th the frost became more intense all over the country; the lowest readings were: —6° at Corwen, —4° at Kelso, —3° at Melrose, —2° at Alston and Lichfield, —1° at Appleby and Coston, and 0° at Thirlestane Castle and Garstang. Readings below 10° prevailed over the southern part of Scotland, the whole of the inland districts of England and Wales, and several parts of Ireland; while the temperature as on the 14th fell below 20° except at a few of the extreme sea-coast stations and the south-west of Ireland.

On the 16th the frost was more intense than on the preceding day, temperatures below zero being registered in the south of Scotland and the north and north-west of England. The lowest readings were: —10° at Stobo, —8° at Kelso, St. Michael's-on-Wyre, and Corwen, —7° at Scaleby and Alston, —5° at Lanark and Sedbergh, —3° at Thirlestane Castle and Wrexham, —2° at Melrose, Haydon Bridge, and Coston, —1° at Blackpool, and 0° at Wolfelee and Chester. Temperatures below 10° were registered over the greater part of Scotland, England, Wales and Ireland, while readings below 20° prevailed except at the extreme sea-coast stations.

On the 17th the temperature fell below zero over the south of Scotland and north of England. The lowest readings* were: —16° at Kelso, —15° at Stobo, —11° at Thirlestane Castle, —10° at Melrose, —9° at Alston, —8° at Haddington and Marchmont, —6° at Corwen, —4° at Braemar and Lanark, —2° at Drumlanrig, and —1° at Cambuslang, Eyemouth, Wolfelee, Haydon Bridge and Sorrel Sykes. Readings below 10° prevailed over the greater part of Scotland, England, Wales and Ireland; while the temperature fell below 20° except at a few of the extreme sea-coast stations.

On the 18th the lowest readings registered were: —15° at Stobo, —12° at Kelso, —10° at Melrose, —8° at Alston, —4° at Achonachie and Wick, and 0° at Culloden and Braemar. Readings below 10° prevailed over the north, central and south-eastern parts of Scotland, and the north, east and west of England, while over the greater part of Scotland and England and the central part of Ireland the temperature fell below 20°. In all other parts of the United Kingdom, except the extreme west and south of Ireland and at Scilly, the temperature was below 30°.

On the 19th the frost was not so severe, readings of 10° and below it being registered only in the south-east of Scotland, at Cardigan and the eastern part of Ireland. Temperatures below 20° prevailed over nearly the whole of Scotland and the central part of Ireland, while readings below 32° were registered generally in the British Isles.

On the 20th the frost became more intense, the region of greatest cold having travelled further south. The lowest readings were: —10° at Cardigan, —4° at Ketton, —3° at Cheltenham, and 0° at Haltwhistle and Stokesay. Readings below 10° were registered in the central and southern parts of

* At Blackadder, in the Merse of Berwickshire, a thermometer registered —22° on this day, but, as it does not appear to have been satisfactorily exposed, the reading has not been used in the preparation of the charts.

Scotland, the north-west, west, and central and south-west parts of England, the greater part of Wales, and in several parts of Ireland. The temperature fell below 20° over almost the whole of the United Kingdom except at the sea coast places, and at no observing station in the British Isles, except at Holyhead, was the minimum temperature at or above 30°.

On the 21st the lowest readings were: —6° at Haydon Bridge, —5° at Cardigan, —3° at Alston and King's Sutton, —2° at Kelso, —1° at Stokesay, and 0° at Cardington. Readings below 10° were registered in the south of Scotland, the north, east, central and south-western parts of England, the greater part of Wales, and the central part of Ireland, while the temperature fell below 20° at all places except a few of the extreme sea-coast stations.

On the 22nd the lowest readings were: —2° at Lanark, —1° at Banbury and Waringstown, and 0° at Addington, Brookborough, Cirencester, and Tunbridge. Readings below 10° were registered in the south of Scotland, the north-west, central, southern and south-western parts of England, and the central part of Ireland; while the temperature fell below 20° except in the eastern part of Scotland, the north-east of England, and at a few of the sea-coast stations. The only place where the thermometer did not fall below 33° was Sandwick in the Orkneys.

On the 23rd the temperature at all places was much warmer than on the previous day, but it has been impossible to draw isotherms, as the minimum of the preceding day is given for the minimum of this day at the stations where the readings are taken at 9 a.m.; while at those stations where the self-registering thermometers are read at 9 p.m. the minimum temperature is from 10° to 20° higher. The actual temperature, however, was not much below the freezing point except in the north-east of Scotland.

On the 24th the temperature had fallen considerably, readings below zero being registered in the south-east of Scotland. The lowest reported were: —7° at Stobo, —4° at Thirlestane Castle, —1° at Melrose, and 0° at Braemar and Haydon Bridge. Readings below 10° prevailed over the central and southern parts of Scotland, the north, east, central, and southern parts of England, and the north-west of Ireland, while temperatures below 20° were registered over the greater part of the United Kingdom except at some of the western stations, and frost occurred except at Sandwick, Falmouth, Penzance and Scilly.

On the 25th the lowest readings were: —7° at Bury St. Edmunds, —6° at Stobo and Cardigan, —4° at Corwen, and—2° at Arncliffe. Readings below 10° were registered in the south of Scotland, the greater part of England and Wales, and the north-west of Ireland. Temperatures below 20° prevailed over the southern half of Scotland, and the whole of England, Wales, and Ireland, except at the extreme west and south-west stations. Frost occurred except at Valencia, Scilly, and the extreme north of Scotland.

On the 26th the cold was more intense in several parts than on the previous day. The lowest readings were: —9° at Sorrel Sykes, —8° at Melrose and Raby Castle, —6° at Haydon Bridge, —5° at Stobo and Thirlestane Castle, —4° at Alston, —3° at Aysgarth, —1° at Churchstoke and Whorlton,

and 0° at Carno. Readings below 10° were registered in the central and south-eastern parts of Scotland, the north, north-west, east and south-west of England, the central part of Wales and the north of Ireland. Temperatures below 20° prevailed over the greater part of Scotland, nearly the whole of England and Wales, and the greater part of Ireland, while readings above 32° were registered only at Sumburgh Head, Sandwick, Scourie, and Roche's Point. During this day the temperature rose till it got above the freezing point, and soon after a thaw became general all over the country.

On the last chart (Plate VIII.) are given the average isotherms over the British Isles for the month of January as prepared by Mr. Buchan from 18 years' observations (1857-69). A glance at this and the preceding chart will be sufficient to show the abnormal character of the temperature of January 1881.

The foregoing remarks on the distribution of low temperatures are confirmed by the following particulars of the freezing of rivers :—

On the 13th. Kirkwall Harbour and Peerie Sea frozen over.

14th. Loch Lomond was frozen over.*
Navigation on the Tay was seriously interrupted by drifting ice.

15th. The intensity of the cold was shown by the circumstance that at Axminster the water froze in the hose of a fire-engine which was trying to play on a fire.

16th. River at Durham was completely frozen over.
The Dee was frozen over at the White House near Chester.
Some portions of the tidal waters of the Towy above and below Carmarthen were covered with ice.
The Exe was covered with such strong ice that people were skating upon it.

17th. The Dee was frozen over at Ballater.
The Earn was frozen across in Perthshire.
The Tay could be crossed from side to side above Perth.
Part of the Tees was frozen over at Stockton, and steam-boat traffic was entirely stopped.
The Ouse at Bedford and the Trent near Weston were frozen over.
The Taff was frozen over at Llandaff.
The Parrett and Bridgewater were completely frozen over.

* A correspondent writes from Glasgow:—"On January 24th I walked with a friend from Balloch to Balmaha, *on Loch Lomond*, landing at Inch Murren. On the following day we walked from Balmaha to Luss, right across the Loch, calling at various islands, and on the 26th we returned from Balmaha to Balloch. To any one acquainted with the situation of these places, it must be evident that the frost must have been of the greatest intensity, as the distances traversed were considerable. The ice was 9 inches in thickness, and covered with a very slight coating of snow.

"Thousands went to and from Balloch to Inch Murren, but I think there were very few that could say they had done what we did. The roar of the ice from time to time was strange, particularly among the islands. Towards the east shore there was a curious *rift* in the ice, as if the ice had been upheaved when forming."

18th. The Severn and all the canals at Worcester were frozen over.

19th. Loch Vennachar was frozen across.

The Medway at Rochester was frozen over.

20th. The Tees was frozen over for some distance below Stockton.

22nd. Both branches of the River Lee at Cork were frozen over until the 25th.

23rd. The Severn at Shrewsbury was completely frozen over.

A sheep was roasted whole on the Thames in a backwater where there is very little current near Twickenham.

24th. The Mersey was frozen over at Warrington for many miles, and nearly as far as Runcorn.

25th. The Trent was frozen over at Nottingham.

26th. On the Loch of Quantinness the ice was in excellent condition.

The South Dock at Sunderland was frozen over.

The Ribble was frozen over below the docks.

All the shipping at Connah's Quay, a port of the Dee, frozen up with masses of ice measuring between 9 and 10 feet thick.

Lough Neagh, which is 12 miles broad and 24 in length, was supposed to be completely frozen over.

Lough Conn, in Co. Mayo, was completely frozen over.

Loch Broom, Rossshire, an arm of the sea, for six miles outward, was covered with ice 6 or 7 inches thick for three weeks, so strong that it was a thoroughfare for the inhabitants.

Skating began on Rydalwater, Elterwater, and some other lakes, on the 8th, and was continued for 21 days without intermission, the ice on Elterwater being one foot in thickness by the end of that period.

The Rev. F. W. Stow's remarks on the freezing of the waterfall at Hardraw Scar, near Hawes, are as follows :—

"The water falls from an overhanging rock 100 feet in height into a deep pool, which the rock encircles for almost a fourth of its circumference. There is a path underneath the rock, passing 20 feet or more to the back of the fall. When severe frost sets in, a hollow icicle is formed from the top, down the inside of which the water passes, and a cone of frozen spray is formed below, where the water falls. In this state I saw it on December 5th, 1879, the icicle being then about 80 feet long and the cone 10 or 15 feet high. It is said by old inhabitants of the village of Hardraw that in 1814, and again in 1838, the icicle approached so near the cone that only a space of 3 or 4 feet intervened, but I can hear of no instance of its being entirely frozen since 1739-40, when its freezing is recorded in Whitaker's "Richmondshire." This makes it very remarkable that the late frost, which began on January 6th and became severe on the 8th, should, at the end of a fortnight from its commencement, have completely congealed it into one immense icicle. This happened, I believe, on the 20th. Certainly it was frozen on the 21st, and I understand it was not frozen on the 18th, but still wanted 8 or 10 feet to join the icicle and the cone. I saw it on the 22nd. Standing underneath the rock and behind the icicle, I could see the falling water through the transparent ice, which was of the most lovely azure hue as viewed

in the sunlight. I judged the icicle to be two-thirds, and the cone of frozen spray one-third of the total height. Of course as soon as the water entered the cone it disappeared entirely, as the frozen spray was opaque and resembled stiff snow. I walked round the cone, the base of which filled most of the pool, and judged it to be about 40 yards in circumference.

"The freezing of Hardraw Scar a week before the end of the frost is to my mind conclusive proof that in this elevated valley no frost so continuously severe has been experienced for 140 years."

Dr. Stuart, of Chirnside, remarks:—"We have had a month of Arctic severity, the roads almost impassable still (Feb. 2) from deep snow. Wood-pigeons were observed to fall to the ground from the trees frozen to death, on the 26th ult., and others, feeding at the sheep boxes in the fields, were so benumbed as to allow themselves to be taken with the hand. The oaks in low situations are completely killed with this third severe winter. Yews planted 60 years ago have been killed down to the ground, and all tender shrubs are completely destroyed."

The Hon. G. Dalrymple's gardener at St. Boswell's, in Roxburghshire, reports that the temperature was —6° on one night, and 0° the next, and that on the night on which it was 6° below zero the large trees were giving off reports like the firing of a gun.

Dr. Compton, of South Bourne, Bournemouth, reports that during the severe frost rooks were eating sparrows, and blackbirds one another.

Some idea of the intensity of the frost may be gathered from the fact that in the south of Scotland the temperature fell below 10° on more than eleven occasions, below 20° on nineteen occasions, and was below 32° on twenty-five to twenty-nine occasions. In the neighbourhood of London readings below 10° occurred on two or three days, below 20° on ten days, and below 32° on twenty days. In Ireland temperatures below 10° were registered on six or seven occasions, below 20° on twelve or fourteen occasions, and below 32° on twenty-two to twenty-four occasions. No place in the British Isles was exempt from the frost, even at Scilly the temperature was below 32° on three days, the lowest being 29° on two occasions. The winter sea-side health resorts afforded no protection from the frost, as the following figures will show:—

	Minimum was below.		Maximum was below.
	32°	20°	32°
Llandudno	on 20 days	6 days	on 2 days
Weston-super-Mare ...	„ 21 „	8 „	„ 8 „
Ilfracombe	„ 16 „	0 „	„ 3 „
Barnstaple	„ 18 „	11 „	„ 4 „
Bude	„ 20 „	9 „	„ 4 „
Penzance	„ 15 „	0 „	„ 2 „
Maker	„ 19 „	8 „	„ 6 „
Plymouth	„ 19 „	8 „	„ 6 „
Torquay	„ 19 „	6 „	„ 5 „

	Minimum was below		Maximum was below
	32°	20°	32°
Teignmouth ...	... on 19 days	on 7 days	on 4 days
Sidmouth ...	... ,, 21 ,,	,, 7 ,,	,, 5 ,,
Bournemouth ...	.. ,, 28 ,,	,, 10 ,,	,, 5 ,,
Ventnor ...	... ,, 19 ,,	,, 8 ,,	,, 2 ,,
Worthing ...	... ,, 23 ,,	,, 10 ,,	,, 6 ,,
St. Leonards ...	... ,, 19 ,,	,, 1 ,,	,, 6 ,,

The effect of the cold upon the mortality of London is shown by the following figures:—

Deaths.	Diseases of the Respiratory Organs.	Difference from Average.	Bronchitis.	Pneumonia.
Week ending Jan. 1	353	—189	218	82
,, ,, ,, 8	363	—132	232	85
,, ,, ,, 15	371	—111	236	95
,, ,, ,, 22	617	+141	441	97
,, ,, ,, 29	702	+249	481	120
,, ,, Feb. 5	606	+ 52	417	120

The heavy falls of snow prevented the frost from penetrating far into the ground, but where the snow was swept away the temperature of the soil fell considerably. In the neighbourhood of London the temperature at the depth of a foot remained stationary at 33° from the 18th to the 29th, while at six inches the extreme range of temperature during the first ten days of the same period only amounted to 0°·3.

The accompanying table (p. 146) gives the mean temperature of January for each year from 1774 to 1881, except for the 5 years 1782-1786 (Plate IX.). From this it will be seen that the low mean temperature of 31°·6 for last month has been surpassed on only 5 occasions, viz. 30°·5 in 1838; 28°·5 in 1814; 25°·5 in 1795; 30°·2 in 1780; and 28°·6 in 1776. The means from 1774 to 1840 are those for Somerset House, as published by Mr. Glaisher in the 'Philosophical Transactions,' while those from 1841 to 1881 are for the Royal Observatory, Greenwich. The extremely low value of 25°·5 in 1795 appears to be rather doubtful, and must be received with some caution. By a further inspection of the Plate IX. it will be seen that the last 3 years, 1879, 1880, and 1881, have been very cold, the mean for this period being only 32°·2, but there is no instance during the past 100 years of January in any 3 consecutive years having so low a mean temperature. This does not bear out Mr. Glaisher's statement that our climate is becoming warmer, and that the month of January is 3° warmer than it was 100 years ago.*

* "Proceedings of the Meteorological Society," Vol. II. p. 365.

TABLE showing the Mean Temperature of January for each Year from 1774 to 1881 in the neighbourhood of London.

Year.	Mean.	Year.	Mean.	Year.	Mean.	Year.	Mean.
	°		°		°		°
1774	33·1	1801	41·1	1828	41·4	1855	34·8
1775	42·0	1802	34·5	1829	33·3	1856	39·3
1776	28·6	1803	35·0	1830	32·3	1857	36·6
1777	35·5	1804	44·8	1831	36·0	1858	37·5
1778	36·4	1805	36·1	1832	38·9	1859	40·4
1779	36·4	1806	42·2	1833	36·1	1860	39·7
1780	30·2	1807	38·3	1834	46·0	1861	33·8
1781	37·8	1808	38·6	1835	39·6	1862	39·0
1782	..	1809	32·0	1836	38·8	1863	41·8
1783	..	1810	36·0	1837	38·8	1864	36·5
1784	..	1811	34·3	1838	30·5	1865	36·3
1785	..	1812	37·5	1839	38·8	1866	42·6
1786	..	1813	36·0	1840	40·6	1867	34·2
1787	38·3	1814	28·5	1841	33·6	1868	37·2
1788	39·0	1815	33·5	1842	32·9	1869	41·1
1789	35·0	1816	38·3	1843	39·9	1870	38·3
1790	40·2	1817	40·8	1844	39·1	1871	33·2
1791	41·4	1818	40·9	1845	38·3	1872	41·3
1792	36·5	1819	41·7	1846	43·7	1873	42·1
1793	36·9	1820	33·3	1847	35·6	1874	41·7
1794	34·9	1821	39·1	1848	34·6	1875	43·3
1795	25·5	1822	41·4	1849	40·1	1876	37·0
1796	46·9	1823	33·4	1850	33·7	1877	42·9
1797	37·0	1824	39·0	1851	42·9	1878	40·4
1798	39·4	1825	40·0	1852	42·0	1879	31·9
1799	34·9	1826	33·6	1853	42·4	1880	33·2
1800	38·5	1827	35·0	1854	39·0	1881	31·6

A table has been prepared giving the lowest temperature observed at over 800 stations, with the date of its occurrence; the number of times the minimum temperature was below 32°, 20°, and 10°; the number of times the maximum temperature was below 32°; the mean maximum and minimum temperatures; the time of reading; the form of stand used; whether the thermometers were verified or not; and the height of the station above sea level.

In conclusion, I should like to point out to all observers the desirability of having their thermometers verified down to at least 12°. The Kew Committee will do this for the small charge of 1s. 6d. for each thermometer. New observers should insist upon the instrument makers supplying them with thermometers graduated to 30° below zero, and verified to 12°.

During the heavy gale on the 18th the index of several minimum thermometers was shaken down some degrees, in one instance to —25°; consequently the readings were too low. It must, therefore, be pointed out that the thermometer should be hung quite horizontally, and firmly fastened to the stand.

I have to express my thanks to all those observers who have supplied me

Station.	Authority.	Minimum Temp. Absolute.	Date.	No. of times below 32°.	20°.	10°.	No. of times Max. below 32°.	Means. Maximum.	Minimum.	Time of Reading.	Stand.	Thers. verified.	Height above Sea Level.
OTLAND.		°						°	°				ft.
rgh Head	D. W. R.	19	13	16	1	0	6	38·4	30·0	8 a.	S.	v.	110
ick	Rev. Dr. Clouston	7·8	18	15	4	1	8	37·6	29·8	9 a.	W.	v.	94
	D. W. R.	− 4	18	23	10	2	5	36·7	23·7	8 a.	S.	v.	76
	J. Simpson	19	13, 14	21	2	0	10	37·2	27·6	9 p.	S.	n.	26
gan	R. Mackintosh	9	17, 18	22	8	2	6	39·1	26·0	9 p.	S.	v.	24
oin	D. Melville	13·0	17	23	6	0	3	38·3	26·5	9 p.	S.	v.	15
achie	W. C. Preston	− 4	18	27	17	7	13	32·8	18·1	9 a.	..	n.	125
n	D. Forbes	4	14	23	13	2	18	32·6	23·0	9.30 a.	S.	v.	104
	D. W. R.	5	14, 18	..	..	3	..	..	..	8 a.	S.	v.	84
en	Rev. Dr. Beverley	8·0	18	25	12	2	10	34·2	23·0	9 a.	..	v.	86
ar	J. Aitken	− 4·0	17	25	20	11	..	33·6	16·4	9 p.	S.	v.	1114
idge	Sergt. A. Fraser	− 0·5	15	25	18	7	13	34·0	19·3	9 p.	S.	v.	310
ar	J. Dickson	4	14, 17	26	19	7	17	32·7	18·2	9 p.	S.	v.	422
mond	J. W. Baillie	7·9	13	26	14	1	8	37·8	21·8	9 p.	S.	v.	533
ch	Capt. Makgill	7·5	17	27	12	3	12	..	22·8	9 a.	W.	v.	98
as	J. R. Ballingall	8·4	16, 22	22	8	2	c	40·0	25·2	9 a.	S.	v.	71
y	Sir J. W. P. Orde	10	16	..	12	0	..	..	..	..	..	..	..
ay	J. Kay	15	16	22	8	0	5	37·6	26·4	9 p.	S.	v.	116
san	D. W. R.	5	17	24	9	1	7	36·9	25·1	8 a.	S.	v.	14
w	Prof. Grant, F.R.S.	8·9	16	24	12	2	14	..	..	10 p.	W.	v.	190
slang	Dr. Muirhead	− 2	16	25	16	8	16	33·2	19·9	9 a.	P.	n.	146
	D. W. R.	9	17, 18	26	8	2	7	35·5	23·0	8 a.	S.	v.	22
gton	C. J. Dods	− 8	17	..	..	..	..	..	..	8.30 a.	W.	n.	140
	C. Lindsay	− 5	16	25	19	11	16	30·9	16·5	9 a.	S.	v.	630
s (near to)	J. Russell	− 5	16, 18	..	..	..	..	..	..	..	..	..	..
	J. Borthwick	− 15	17, 18	25	19	12	19	31·4	13·5	9 a.	..	..	600
tane Castle	J. Whitton	− 11	17	25	21	12	17	31·4	13·7	9 p.	S.	n.	558
nont	P. Loney	2	17	27	14	3	9	35·1	21·2	9 a.	S.	v.	500
ath	A. Pirie	− 1	17	25	10	3	7	36·0	21·6	9 p.	S.	n.	16
	G. Wemyss	− 16	17	27	19	11	19	30·0	13·0	9 a.	S.	v.	130
	A. B. Dodds	− 10	17	29	19	12	16	30·9	13·0	9 p.	..	..	280
e	D. M'Pherson	− 1	17	26	16	10	17	33·9	18·4	9 p.	S.	v.	601
nrig	D. Thomson	− 2	17	26	20	11	16	34·2	17·1	9 p.	S.	v.	191
es	A. Bruce	3·5	17	27	18	7	13	33·9	18·6	9 a.	..	..	159
	J. Wood	13	17	21	10	0	6	36·4	25·5	9 p.	S.	v.	140
	P. Dudgeon	7·0	17	21	14	2	12	34·5	23·8	9 p.	S.	v.	86
rick	Dr. Urquhart	17·5	22	21	3	0	4	37·7	28·7	9 p.	S.	v.	22
GLAND.													
r	J. Lingwood	0·1	26	22	12	2	4	36·8	23·1	9 p.	S.	v.	214
	D. W. R.	6	27	22	11	3	6	36·2	24·4	8 a.	S.	v.	98
	W. J. Tone	7	17	23	12	7	18	31·5	22·6	9 a.	W.	v.	87
ge-on-Tyne	T. G. Hurst	3	17, 26	23	11	6	13	32·1	22·5	9 a.	..	..	275
Bridge	T. J. Bewick	− 6·0	21, 26	25	16	10	15	33·5	17·3	9 a.	S.	n.	291
istle	Rev. D. Brown	− 1	25	..	..	7	..	..	..	..	..	..	167
	T. Dickinson	− 9	17	24	20	14	15	33·0	13·5	9 a.	S.	v.	1145
m	T. H. Walker	2·0	16	24	19	7	14	33·3	19·5	9 a.	S.	v.	400
	R. A. Allison	− 7·0	16	21	16	10	17	33·2	19·7	9 p.	S.	v.	111
	Rev. F. Redford	0·0	16	21	15	7	17	32·7	21·4	9 p.	S.	v.	29
nouth	Dr. Dodgson	4·4	16	23	20	7	16	34·5	20·2	9 a.	S.	v.	144
ite	W. Dixon	6·9	16	24	17	5	16	34·1	20·8	9 a.	S.	v.	389
ter	E. Tucker	3	16	22	15	6	10	..	..	..	S.	..	..
h	J. Dockeray	− 5	16	..	..	..	..	..	..	..	..	..	..
h	Rev. F. W. Stow	− 2·8	26	26	14	6	18	32·8	20·3	9 p.	S.	v.	660
ykes	Rev. F. W. Stow	− 9·0	26	25	14	9	15	32·7	18·0	9 a.	..	v.	500
	G. A. Goldney	0·2	17	24	11	6	9	34·6	21·7	10 p.	S.	v.	340
istle	R. Westcott	− 8	26	..	..	..	..	..	..	..	..	..	..
yton	Mrs. Maynard	1	25	..	..	..	..	..	..	..	..	..	113
Grange	I. L. Bell, F.R.S.	4	16, 17	..	..	..	..	..	..	9 a.	S.	v.	200
n	*Miss Dodgson*	− 1	26	..	..	..	..	..	..	..	..	..	142

Station.	Authority.	Minimum Temp.					Max.	Means.		Time of Reading.	Stand.
		Absolute.	Date.	No. of times below			No. of times below 32°.	Maximum.	Minimum.		
				32°.	20°.	10°.					
ENGLAND.		°						°	°		
Ripon		− 3	17	..	..	..	..	..	..	..	
Harrogate	J. McLandsborough	10·0	25	25	10	0	11	34·8	24·2	8.30 a.	W
York	J. Wright	1·0	15	22	14	4	10	33·6	22·6	9 p.	S.
Scarborough (St. N.)	J. McClelland	7·7	26	19	8	1	7	36·2	25·6	9 a.	S.
Scarborough	F. Shaw	10·5	26	18	4	0	10	35·8	28·6	9 p.	S.
Spurn Head	D. W. R.	19	18	..	1	0	..	..	..	8 a.	S.
Hull	E. Peak	6	21	22	11	4	9	..	..	9 p.	W
Killingholme	Rev. J. Byron	9	15, 21	19	10	2	11	32·7	25·1	9 a.	W.
Appleby	Rev. J. E. Cross	− 1·0	15	23	12	6	12	33·2	21·8	10 a.	..
Kelstern	D. G. Briggs	2·5	15	21	12	2	12	33·6	23·5	9 p.	S.
Partney	Rev. T. Owston	4	17	..	..	..	..	..	..	..	..
Bucknall	W. Carter	5	15, 16	23	12	5	11	34·4	22·9	4 p.	W.
Skegness	G. Randall	7	24	..	..	..	..	..	..	..	..
Boston	W. H. Wheeler	2	15	22	..	..	..	..	..	..	
Broughton-in-Frns.	Rev. F. A. Malleson	− 5	..	..	..	..	..	..	..	..	..
Barrow-in-Furness	D. W. R.	15	16, 26	22	10	0	3	..	..	8 a.	S.
Garstang	S. King	− 4	16	23	18	6	17	33·9	19·7	9 a.	S.
St. Michl's.-on-Wyre	Rev. P. J. Hornby	− 7·5	16	22	19	11	13	35·8	19·7	9 a.	S.
Blackpool	C. T. Ward	− 0·5	16	21	17	5	13	35·5	21·6	9 a.	S.
Stonyhurst	Rev. S. J. Perry, F.R.S.	7·0	16	23	11	1	13	..	..	10 p.	W.
Blackburn	W. B. Bryan	6·4	16	23	17	3	12	35·3	21·2	9 a.	S.
Chorley	T. Hare	0	16	..	..	..	..	..	..	..	..
Arncliff	Rev. W. Boyd	− 2	25	21	..	..	..	..	..	..	..
Leeds	H. Crowther	12	26	20	7	0	..	..	26·5	10 a.	..
Stanley	Rev. R. Burrell	9	15	24	10	1	12	34·4	24·7	8.30 a.	..
Wakefield	H. Clarke	12·1	18	21	11	0	10	35·7	25·1	9 p.	S
Bradford	J. McLandsborough	12·0	26	22	8	0	12	34·7	25·9	9 a.	W
Halifax	J. Gledhill	10·0	16, 20	24	12	0	11	..	22·0	9 a.	G
Bolton	Rev. T. Mackereth	0·8	16	24	15	2	12	34·9	22·7	9 a.	S
Prestwich	H. R. O. Sankey	8·0	16	21	13	2	14	34·4	23·5	9 a.	S
Macclesfield	J. Dale	3·3	16	21	14	5	16	35·3	22·3	9 a.	S
Buxton	Dr. Sykes	1·2	25	23	17	6	16	33·5	19·8	9 p.	S
Sheffield	W. F. Cooper	3·0	16	21	11	6	10	35·5	23·0	11 p.	W
,, (Brom. Pk.)	D. Doncaster, Jun.	10·9	25	20	11	0	10	34·8	25·3	9 a.	.
Hesley Hall	B. J. Whitaker	6	20	22	11	3	12	34·5	23·8	..	.
Hodsock	H. Mellish	1·6	21	25	12	7	11	35·3	21·5	9 a.	S
Mansfield	W. Tyrer	6·0	15	22	11	6	13	34·0	23·1	9 p.	S
Belper	J. Hunter, Jun.	6·5	15	24	12	3	12	34·6	23·4	9 a.	S
Beacon Stoop	C. L. Wragge	7·7	26	24	10	1	15	33·7	24·0	9 a.	S
Farley	C. L. Wragge	10·7	26	22	13	0	14	34·8	23·6	9 a.	S
Oakamoor	C. L. Wragge	3·1	16, 17	23	16	7	14	35·0	20·8	9 a.	S
Cheadle	J. C. Philips	9·9	25	21	12	1	4	33·7	24·2	9 p.	S
Tean	Rev. G. T. Ryves	5·0	17	22	13	4	13	34·9	22·5	9 a.	G
Lichfield	E. Sellick	− 2·0	15	..	..	..	..	..	..	..	.
Burton-on-Trent	C. U. Tripp	4	15, 17	22	14	4	10	34·0	21·2	9 a.	.
Trent College	C. U. Tripp	1	14	23	14	5	9	35·6	20·8	9 a.	.
Strelley	T. L. K. Edge	0·8	15	23	13	2	12	34·3	22·6	9 a.	S
Nottingham	M. O. Tarbotton	1·7	15	23	15	4	11	34·5	21·6	9 a.	G
Loughborough	W. Berridge	1·9	15, 16	23	13	6	11	35·0	21·8	9 a.	S
Coston	Rev. A. M. Randall	− 2	16	25	14	7	12	33·2	20·5	9 a.	S
Ketton	F. Coventry	− 4	20	27	12	7	7	38·0	..	9 a.	W
Uppingham	Rev. G. H. Mullins	9·5	16	22	12	1	13	34·3	24·8	9 p.	S
Leicester	J. E. Carryer	5·2	15	22	10	1	12	34·4	24·1	9 p.	S
Wrottesley	E. Simpson	4·3	16	24	15	8	17	33·4	21·3	9 a.	S
Oscott	Rev. R. Pate	7·6	25	22	11	1	11	34·9	23·9	9 p.	S
Coventry	J. Gulson	3	15	25	14	4	10	..	..	9 a.	W
Kenilworth	F. Slade	3·7	22	23	13	5	12	33·7	21·9	9 a.	S
Rugby	Rev. T. N. Hutchinson	5·6	15	22	11	5	14	33·3	23·3	8.15 a.	.
Weedon (Floore)	E. G. Loder	− 1	21	..	..	6	..	..	..	9 a.	.
[illegible]rthampton	H. Terry	8	19	23	..	..	10	..	..	9 a.	W

tation.	Authority.	Minimum Temp. Absolute.	Date.	No. of times below 32°.	20°.	10°.	No. of times Max. below 32°.	Means. Maximum.	Minimum.	Time of Reading.	Stand.	Thers. verified.	Height above Sea Level.
GLAND.		°						°	°				ft.
Sutton	E. Good	− 3	21	..	..	..	..	..	..	..	..	..	..
n	A. R. Tawney	8·5	22	24	..	..	..	..	..	..	..	..	197
y	T. Beesley	7·0	15	21	14	2	11	34·3	23·2	9 a.	L.	v.	343
n	Rev. A. Robinson	− 5	22	..	..	9	..	..	..	8 a.	W.	..	..
	D. W. R.	7	22	21	14	3	12	35·5	23·7	8 a.	S.	v.	210
on	J. Mathison	0	22	23	13	7	11	34·2	22·4	9 a.	S.	n.	309
npstead	W. Squire	5	21	21	10	4	12	..	24·2	..	G.	v.	370
Guise	E. E. Dymond	6·9	22	22	12	3	15	34·5	25·7	9 a.	S.	v.	433
ton	J. McLaren	0·0	21	21	13	4	12	35·1	22·7	9 a.	G.	n.	109
	W. Lucas	5	20	24	10	2	13	32·9	23·4	9 a.	W.	n.	28
ng	Rev. C. W. Harvey	10·7	22	23	14	0	16	33·5	23·5	9 a.	S.	v.	484
	H. Wortham	7·7	22	..	..	2	..	..	..	10 a.	G.	n.	269
	H. Huntley	9	15, 17	22	13	2	10	35·9	23·4	9 a.	B.	v.	273
g	Rev. E. Hill	9	17	22	10	1	13	34·3	25·1	9 a.	W.	n.	214
Walden	R. Bellingham	2	21	21	11	1	12	35·3	..	9 p.	S.	v.	182
lge	D. W. R.	4	21	22	13	2	10	35·7	23·1	8 a.	S.	v.	90
Edmund's		1	21, 25	23	..	..	..	..	..	..	..	..	..
idge	Lord Rendlesham	4	26	..	..	3	..	..	..	..	..	..	..
	H. Culley	1	26	23	12	9	10	35·8	22·0	9 a.	W.	v.	40
m	E. T. Dowson	3·5	26	21	11	3	8	36·4	24·5	9 p.	S.	v.	40
yton	Rev. C. J. Steward	4·9	26	20	10	5	10	36·0	24·4	9 a.	S.	v.	50
ft	S H. Miller	9·2	15	19	6	1	6	36·7	27·3	9 p.	S.	v.	85
ih	D. W. R.	10	15, 16	20	6	0	7	35·8	27·2	8 a.	S.	v.	10
	J. Cooper	12·0	17	20	8	0	3	..	26·7	9 a.	..	v.	90
gham	S. Cushing	8·5	25	..	..	..	..	..	..	..	..	..	190
on	Rev. H. Ffolkes	1·3	26	23	12	9	12	34·9	22·6	9 p.	S.	v.	88
l	A. R. Andersson	4	16	22	12	2	16	33·5	..	8 a.	S.	n.	119
	D. W. R.	9	26	20	8	1	10	35·1	25·8	8 a.	S.	v.	180
on	R. Bushell	0·1	16	22	10	4	14	34·8	24·1	8 a.	S.	v.	218
	A. O. Walker	0·8	16	22	11	5	10	34·7	23·5	9 a.	S.	v.	64
Bay	A. O. Walker	14·2	21	21	6	0	4	38·6	28·2	9 a.	S.	v.	180
no	Dr. Nicol	* 14·5	26	20	6	0	2	39·2	29·4	9 p.	S.	v.	79
d	D. W. R.	24	15	18	0	0	0	..	32·4	8 a.	S.	v.	44
	J. Bennett	− 8	16	23	13	9	..	..	..	..	.	..	157
n	B. T. G. Boscawen	— 2·5	16	..	..	..	..	..	..	..	..	..	192
	F. G. Tippinge	8	15	22	14	3	12	34·8	22·7	9 a.	..	v.	310
	Rev. E. V. Pigott	1·0	16	22	13	8	15	33·4	19·7	9 p.	S.	v.	266
	Miss Marsh	0	26	26	..	..	..	..	..	..	..	..	595
oke	P. Wright	— 1·0	26	21	13	8	16	33·6	21·5	9 p.	S.	v.	549
	Rev. J. D. La Touche	— 0·9	21	23	15	8	12	34·4	19·9	9 p.	S.	v.	374
lge	C. Webb	5	14	..	14	7	13	..	..	..	S.	v.	..
	T. H. Davis	4·3	22	..	11	7	.	..	..	..	..	..	..
Frome	Rev. M. Hopton	4	22	..	..	..	..	..	..	..	..	..	175
e	Rev. T. West	4	21, 22	..	..	..	..	..	..	..	W.	n.	192
	Dr. Chapman	1·1	15	22	14	8	10	35·0	21·3	9 a.	S.	v.	275
	H. Southall	2·9	21	22	14	8	13	34·5	22·1	9 a.	S.	..	213
	R. L. Lloyd	2	15, 17	..	..	6	..	..	..	9 a.	..	..	212
	H. Howard	—10	20	..	14	9	..	..	..	..	..	n.	206
's	Dr. Propert	16·1	26	21	4	0	4	38·7	29·1	9 a.	S.	v.	189
Head	D. W. R.	19	15	..	1	0	..	..	..	8 a.	S.	v.	150
lwest	E. P. Phillips	1	20	22	12	6	10	35·3	22·6	9 a.	..	v.	94
en	Dr. Hearder	3·8	15	20	11	4	8	37·9	25·1	9 p.	S.	v.	188
ry	J. Watkins	4	15	..	..	..	..	..	..	..	..	..	208
	W. Adams	13·4	23	19	9	0	7	36·8	27·1	9 a.	S.	v.	43
fa	F. J. Mitchell	11	15	21	10	0	10	..	26·2	9 a.	W.	v.	326
am	R. Tyrer	− 3·3	20	22	14	9	13	34·4	20·7	9 p.	S.	v.	184
er	Prof. Ohm	— 0·3	22	23	12	4	15	33·1	22·7	..	..	..	..
Bassett	J. Allen	3	15, 16	23	12	5	17	..	22·2	9 a.	..	v.	400
igh	Rev. T. A. Preston	6·9	15	22	12	3	11	35·2	24·5	9 p.	S.	v.	471
	R. Lovelock, Jun.	6	15	..	..	..	..	..	..	..	G.	..	..
ch	Rev. J. Slatter	5·3	17	21	11	2	12	..	23·9	9 a.	J.	v.	150

Station.	Authority.	Minimum Temp.		No. of times below			No. of times Max. below 32.°	Means.		Time of Reading.	Stand.	Thers. verified.	Height above Sea Level.
		Absolute.	Date.	32.°	20°.	10°.		Maximum.	Minimum.				
ENGLAND.		°						°	°				ft.
Purley	Hon. R. Boyle	0	17	..	..	..	..	..	..	..	..	..	..
Holt	Major Gritton	5·5	17	20	12	6	11	34·8	24·3	9 a.	S.	v.	120
Wilton	T. Challis	2·5	22	23	14	4	6	37·4	21·6	9 a.	G.	v.	180
Downside	Rev. T. L. Almond	8·8	15	20	11	1	11	35·2	25·2	9 p.	S.	v.	592
Bristol	W. F. Denning	8·5	15	..	11	4	..	..	..	9 a.	..	..	200
Weston-super-Mare	W. E. Perrett	14·0	15	21	8	0	8	37·7	28·2	9 a.	S.	v.	20
Ilfracombe	M. W. Tattam	20·0	26	16	0	0	3	41·0	32·3	9 a.	..	v.	25
Arlington Court	Lady Chichester	11	15, 26	21	10	0	7	37·0	25·9	..	..	..	..
Barnstaple	W. Knill	8	26	18	11	2	4	39·2	26·7	..	S.	v.	43
Northam	Rev. N. Churchward	8	25	..	11	1	6	..	..	..	..	..	..
Bude	J. Arthur	3·7	22	20	9	4	4	39·4	25·4	9 a.	S.	v.	16
Altarnun	Rev. J. Power	3	26	23	14	6	6	38·4	22·1	9 a.	..	n.	570
Penzance	W. H. Richards	21	22	15	0	0	2	40·2	33·7	9 a.	W.	n.	67
Falmouth	L. Squire	22·8	22	16	0	0	2	..	..	10 p.	W.	v.	200
Truro	W. Newcombe	12	15	18	7	0	2	42·0	28·1	9 a.	..	v.	56
Bodmin	Capt. Liddell	12	6	20	..	..	..	..	..	..	..	..	232
Maker	Rev. P. H. Newnham	17·3	21	19	8	0	6	39·5	29·6	9 a.	S.	v.	290
Plymouth	Dr. Merrifield	17·0	20	19	8	0	6	39·8	28·8	8 a.	W.	v.	69
Prawle Point	D. W. R.	17	20	15	2	0	3	..	..	8 a.	S.	v.	330
Dartmoor	W. H. Tooker	10·0	25	21	..	0	..	..	..	9 p.	S.	v.	1360
Ashburton	F. Amery	15·6	22	21	5	0	6	38·9	27·9	9 a.	S.	v.	584
Bridgetown	T. H. Edmonds	8·8	23	20	11	2	3	40·8	25·4	9 a.	S.	v.	107
Torquay, Castle Col.	C. J. Harland	18·0	22	20	5	0	6	39·2	29·3	9 a.	S.	v.	166
,, Rocombe	H. Hearder	15·6	22	19	6	0	5	39·9	29·1	9 a.	S.	v.	400
Babbacombe	E. E. Glyde	15·3	20	19	7	0	3	40·6	29·5	9 p.	S.	v.	494
Teignmouth, Bitton	Dr. Lake	15·7	22	19	7	0	4	41·4	29·0	9 a.	S.	v.	50
,, Woodway	G. W. Ormerod	11·3	22	21	7	0	2	41·7	27·0	9 a.	S.	v.	235
Brampford Speke	W. H. Gamlen	10·6	16	22	11	0	11	35·9	24·6	9 a.	S.	v.	140
Cullompton	T. Turner	7·1	20	21	10	1	8	37·1	24·1	9 a.	S.	v.	202
Sidmouth	Dr. Radford	13·0	22	21	7	0	5	38·4	27·6	9 a.	S.	v.	186
Langton Herring	Rev. C. H. Gosset	13	22	20	5	0	10	36·0	27·8	9 a.	W.	n.	200
Swanage	B. Jumeaux	12·7	22	19	7	0	5	38·2	28·7	9 a.	S.	v.	178
Bournemouth	Sir B. J. Sulivan	11·2	22	23	10	0	5	38·7	25·8	9 a.	S.	v.	134
South Bourne	Dr. Compton	12·1	24	20	10	0	6	37·3	27·1	9 p.	S.	v.	90
Hurst Castle	D. W. R.	15	22, 23	18	7	0	5	38·3	28·3	8 a.	S.	v.	14
Ventnor	J. Codling	14·9	22	19	3	0	2	40·4	29·4	9 a.	S.	v.	80
Osborne	J. R. Mann	13·8	22	23	9	0	7	37·8	26·7	9 a.	..	v.	172
Portsmouth	R. E. Power	7·4	22	29	14	4	5	37·9	20·7	9 a.	S.	v.	20
Woolston	F. Ekless	8·4	24	24	..	2	8	..	..	9 a.	G.	v.	83
Southampton, O.S.O.	Col. R. E. Cooke	13·2	15	20	8	0	6	37·3	27·0	9 p.	S.	v.	74
,, Highfield	Rev. H. Garrett	8·1	24	23	10	1	7	37·3	24·7	9 a.	S.	v.	140
Harestock	Col. H. S. Knight	6·1	15	22	12	1	11	35·7	24·7	9 a.	S.	v.	304
Swarraton	Rev. W. L. W. Eyre	6·1	17	22	13	4	12	35·3	23·6	9 a.	S.	v.	310
Ashdell	F. Crowley	5·0	17	..	9	3	..	..	..	..	B.	v.	396
Stoke	Major Mathew	6·0	22	22	12	3	..	..	23·7	9 a.	W.	..	170
Guildford	J. R. Capron	11·5	15	..	..	..	..	..	..	1 p.	S.	v.	209
Cranleigh	J. Bryan	7·1	17	23	13	4	7	37·8	23·3	9 a.	S.	v.	125
Strathfield Turgiss	Rev. C. H. Griffith	3·9	22	21	13	6	10	36·0	23·5	9 p.	S.	v.	195
Cookham	Rev. R. W. Rogers	3	15	..	..	..	..	..	..	8.30 a.	..	..	..
Cooper's Hill	Prof. McLeod	8·5	15	21	11	1	12	35·7	25·6	9 a.	S.	v.	280
Watford	J. Hopkinson	6·4	21	23	11	5	12	35·1	24·1	9 a.	S.	v.	223
Rothamstead	T. Wilson	5·0	21	21	11	4	14	35·1	24·4	9 p.	S.	v.	419
Finchley	H. C. Stephens	8·4	15	22	12	2	13	35·6	24·6	9 a.	S.	v.	275
Enfield	T. Paulin	7·9	21	23	9	2	11	35·8	24·9	9 a.	..	v.	300
Hornsey	J. Thrustans	10·0	17	17	10	0	9	36·8	26·5	9 a.	..	..	125
Chigwell Row	J. Campbell	13·8	22	20	10	0	10	36·7	26·9	9 p.	S.	v.	206
Hackney	Dr. Tripe	12·6	17	21	9	0	12	36·8	27·2	9 a.	S.	v.	59
Camden Square	G. J. Symons, F.R.S.	11·8	17	20	12	0	10	36·7	26·1	9 a.	G.	v.	111
Regent's Park	W. Sowerby	9·8	15	21	11	1	11	36·4	26·3	9 a.	S.	v.	125
Isleworth	*Miss E. A. Ormerod*	4·6	17	21	13	5	11	36·2	24·0	9 a.	S.	v.	68
Kew	*G. M. Whipple*	4·7	17	20	11	5	11	36·3	25·2	9 p.	S.	v.	21

Station.	Authority.	Minimum Temp. Absolute.	Minimum Temp. Date.	No. of times below 32°.	No. of times below 20°.	No. of times below 10°.	No. of times Max. below 32°.	Means. Maximum.	Means. Minimum.	Time of Reading.	Stand.	Thers. verified.	Height above Sea Level.
NGLAND.		°						°	°				ft.
ood	W. Marriott	10·8	17	19	10	0	12	36·2	26·7	9 p.	S.	v.	184
Norwood	W. Stanley	11·1	17	21	12	0	12	36·3	25·5	9 a.	S.	v.	190
on	E. Mawley	11·6	21	20	9	0	12	36·2	26·6	9 a.	S.	v.	201
nham	P. Bicknell	6·7	21	22	11	4	10	36·6	24·4	9 a.	G.	v.	142
wich	Sir G. B. Airy, F.R.S.	12·7	17	18	10	0	12	36·2	27·3	9 p.	G.	v.	155
m	E. J. C. Smith	5·8	17	18	..	3	11	35·9	..	9 p.	S.	n.	80
ngton	S. Rostron	7·2	22	21	13	5	10	36·4	23·8	9 a.	S.	v.	90
ham	Rev. A. Cheales	— 1	25	..	11	4	..	..	..	..	S.	..	200
am	G. Dines	2·0	25	..	..	..	..	..	..	9 a.	G.	v.	55
ard's Heath	Rev. T. E. Crallan	8·0	22, 23	23	11	2	8	37·6	24·9	9 a.	P.	v.	250
hampton	G. Neame	10	22	23	8	0	13	..	25·2	..	..	..	152
ing	W. J. Harris	13·5	22	23	10	0	6	37·7	26·9	9 a.	S.	v.	21
on	F. E. Sawyer	11·4	22	..	4	0	8	..	..	..	..	..	206
ourne	S. Bretton	15·1	22	21	5	0	4	38·6	27·8	9 a.	S.	v.	24
onard's	H. Colborne	16·7	22	19	1	0	6	38·4	29·7	9 p.	S.	v.	116
rden	J. E. Mace, Jun.	10	22	21	6	0	10	36·1	27·1	9 a.	W.	n.	194
orough Beacon	C. L. Prince	9·0	22	23	9	1	15	34·4	26·3	9 a.	S.	v.	780
idge Wells	F. Green	7·2	22	23	10	1	13	35·3	25·2	9 a.	S.	v.	500
idge	W. C. Punnett	0·5	22	21	9	2	10	36·4	25·5	9 a.	S.	v.	99
rooke	G. Pile	4	22	..	..	2	..	..	..	..	..	..	224
tone	P. Goddard	1	21	22	9	2	7	36·9	25·6	..	..	..	80
am	Col. C. Warren	14·3	26	18	9	0	10	36·5	27·5	9 p.	S.	v.	135
	D. W. R.	18	22, 23	17	2	0	4	37·7	29·9	8 a.	W.	v.	30
gate	Rev. T. E. Egan	15·0	15	18	4	0	3	37·8	29·1	9 p.	S.	v.	105
RELAND.													
ana	T. Colquhoun	13	24, 25	19	7	0	1	43·7	26·9	9 a.	W.	n.	15
ady	T. A. Mercer	7·6	25	22	12	2	7	37·7	24·6	9 a.	S.	v.	65
nderry	J. Conroy	11·8	17	21	9	0	11	36·3	25·4	9 p.	S.	v.	93
ullen	C. H. Cochrane	6	25	..	8	2	..	..	..	..	..	..	..
	Sir N. Staples	9	16, 18, 26	21	12	3	0	38·9	23·8	9 a.	S.	v.	305
gstown	Major Waring	— 1	22	23	14	6	3	38·2	22·5	9 a.	J.	v.	191
e	L. Turtle	4	22	22	12	5	9	36·8	23·5	9 a.	S.	v.	130
de	Col. Forde	4	16	24	6	5	..	..	..	..	..	..	..
hadee	D. W. R.	14	17	19	3	0	1	39·2	30·4	8 a.	S.	v.	37
h	S. Call	9·8	17	21	10	1	14	..	..	10 p.	W.	v.	206
ooke Park	M. Ferguson	0·0	22	20	13	5	6	36·5	23·1	9 p.	S.	v.	230
e Castle	E. Salis	— 2·3	16	21	14	9	9	37·0	20·7	9 p.	S.	v.	132
hmore	D. W. R.	14	15	19	3	0	1	40·2	30·0	8 a.	S.	v.	36
oe	J. Pratt	0	22	..	15	8	..	..	..	..	..	..	238
y	Prof. Larmor	13	17, 20, 22	18	12	0	..	..	..	..	..	..	215
aloe	W. H. Kempster	8	16	22	9	1	15	33·5	25·4	9 a.	W.	n.	162
rd	J. Hodgson	8	22	24	10	1	11	35·4	24·6	9 a.	W.	n.	185
stown	D. W. R.	6	21, 22, 23	21	14	4	9	36·5	22·7	8 a.	S.	v.	186
ere	J. Baylis	6	21	..	..	1	..	..	..	..	..	..	..
, O.S.O.	Col. C. N. Martin	4·0	25	23	10	3	7	38·1	24·1	9 p.	S.	v.	162
town	G. Pim	11	17	14	..	..	..	..	..	..	..	..	..
e	J. Digan	7	16, 17	22	8	2	9	38·5	25·0	9 a.	..	..	115
	J. Hill	12	16	..	..	..	..	..	..	..	..	..	156
ia	D. W. R.	24	20, 21, 22	17	0	0	0	44·5	32·8	8 a.	S.	v.	20
Rock	J. B. Binyon	8	15	21	7	1	..	..	..	..	..	..	194
	Dr. Caulfield	14	16	16	3	0	5	39·0	31·5	..	..	..	70
s Point	D. W. R.	22	21	13	0	0	3	41·0	32·7	8 a.	S.	v.	37
llins	C. Budds	10	19	28	..	..	..	..	..	..	..	..	193
ord	J. Neale	10	17	21	8	0	7	..	26·4	9 a.	S.	n.	60

Station.	Authority.	Minimum Temp.					No. of times Max. below 32°.	Means.		Time of Reading.	Stand.	Thers. verified.	Height above
		Absolute.	Date.	No. of times below				Maximum.	Minimum.				
				32°.	20°.	10°.							
		°						°	°				ft
Cronkbourne, Isle of Man	A. S. Melkham	12·0	17	22	6	0	5	37·9	27·4	9 p.	S.	v.	1
Scilly	D. W. R.	29	19, 20, 22	5	0	0	0	44·5	37·7	8 a.	S.	v.	
Guernsey	Dr. Carey	26·4	16	7	0	0	0	42·4	35·2	9 a.	S.	v.	1
,,	A. Collenette	24·6	16	9	0	0	0	41·9	34·9	8 a.	G.	v.	1
Jersey, Millbrook	P. Langlois	21·0	22	19	0	0	0	42·2	32·4	9 p.	S.	v.	
,, St. Aubin's	J. E. Vibert	21·3	22	14	0	0	0	41·8	33·2	9 p.	S.	v.	1

NOTE.—D. W. R. indicates Daily Weather Report; B. Barrow, G. Glaisher, J. James, L. Lawson, Pastorelli, S. Stevenson, W. Wall Screen: v. verified, and n. not verified. The height abo Mean Sea Level is that of the ground under the thermometers.

with their readings, and also to the President for the quantity of material which he has placed at my disposal.

DISCUSSION.

The Rev. F W. STOW, in a note to the Secretary, said:—"Two years ago, in a paper on Thaws which I had the honour to submit to the Society, I took occasion incidentally to give expression to the opinion on the cause of extreme cold in valleys, &c., which I imagine to be pretty generally held by meteorologists. What I said amounted to this, that the air chilled by contact with the radiating ground is either removed by a breeze, or slowly gravitates downwards till it reaches a position in which it comes to rest, where, remaining in contact with the radiating surface of the ground, it becomes more and more chilled as long as the conditions favourable to that result continue.

"It follows then that, given (1) a cloudless and remarkably still night—such as with us often precedes a change, (2) a situation out of which the cold air cannot escape by gravitation, and (3) a thick coating of light powdery snow, which is an admirable radiator and a bad conductor, covering the ground, the air near the ground will be chilled at least till the dew-point is reached. Then, as the temperature continues to fall, fog is formed; but in spite of the heat evolved in the condensation of vapour, the cold will under favourable circumstances continue to increase, till the fog becomes high and dense enough to exclude radiation. It is evident, therefore, that in estimating the temperature likely to be reached, account must be taken of the *dryness* of the air. A low dew-point renders extreme frost possible in the plains.

"The determination of the dew-point is admitted to be a different matter. No hygrometer whatever is of the least use at low-lying stations in extreme frost, even in the hands of the best of observers, because the air at such stations is then chilled below its natural dew-point. In ordinary weather I have usually found the dew point very slowly diminish with elevation; for instance, in an ascent of Snowdon, in the account of which I appear as the Rev. M. Snow—(see Proceedings of the Met. Soc. Vol. IV. p. 272)—I found the dew-point vary only about 3° within 2,000 feet while the temperature changed more than three times that amount. It is fair, therefore, to take the dew-point observed at a moderately elevated station, say not exceeding 1,000 feet, as a close approximation to the dew-point which might be observed on the plains but for this accumulation of cold air below. Thus while at Ripon, a low-lying station, I found in the severe weather in January, 1867, a dew-point simply following the air temperature; the

observations which I took at Red Hall, near Leeds (450 feet) in December, 1860, and those, again, taken recently at Aysgarth, appear to give satisfactory results when worked out by Glaisher's Tables. Perhaps I ought to add that when I speak of fog I use a comparative term. I do not mean necessarily a London fog, or anything like it. The thinnest possible haze, which you are unaware of till you see it from a distance lying in the valley from which you have emerged, is of the same nature and in part at least vitiates the results obtained from hygrometers. I saw one day in the late frost from above a fog or frost-haze so thin that when in it I could have seen through ten miles of it. And yet I dare say it affected the reading of the wet-bulb, if there was one in it.

Dry Bulb, Wet Bulb and Dew Point Temperature Observations in Severe Frost.

Station.	Hour.	Dry.	Wet.	Dew Point.	Min. at 4 ft.	Radn. Min. on Snow.	Min. in Valley.
		°	°	°	°	°	°
At Red Hall near Leeds, 450 ft. 1860							
December 24	9 a.m.	18·0	14·5	+2·9	16·0	?	?
	3 p.m.	20·0	17·5	—0.3	..	..	..
„ 25	9 a.m.	12·5	11·0	—0·7	11·5	0° or lower	—9·7*
	3 p.m.	17·0	15·0	—0·2	..	..	..
At Aysgarth Vicarage, 650 ft. 1878							
December 13	9 a.m.	11·5	11·0	+7·1	7·2	—0·5	—3?
At Aysgarth Vicarage, 1879							
December 4	9 a.m.	11·5	11·0	+7·1	2·9	—2·0	—4·7
	9 p.m.	16·0	13·9	—2·3	12·2	—1·0	—1·8
At Aysgarth Vicarage, 1881							
January 14	9 a.m.	15·8	15·1	+ 9·7	11·2	+6·0	+ 1·0
	9 p.m	14·5	13·8	+ 8·9	..	..	..
„ 15	9 a.m.	19·3	18·1	+ 9·4	8·2	4·0	..
	9 p.m.	16·3	15·1	+ 5·9	..	..	..
„ 16	9 a.m.	13·8	12·3	+ 0·6	9·1	1·0	— 4·0
	9 p.m.	19·8	19·0	+13·3	..	..	..
„ 17	9 a.m.	6·5	5·8	+ 0·3	1·9	—0·5	— 7·0
„ 25	9 a.m.	18·0	17·0	+ 9·5	13·0	4·0	+ 2·0
	9 p.m.	11·3	10·8	+ 6·9	..	..	..
„ 26	9 a.m.	—1·0	—1·0	?	—2·8	—10·0	—13·2
At Rossinières, Switzerland, 1879 ..							
December 9	9 a.m.	—4·0	—4·7	..	—12·5	—24·5	—37
	9 p.m.	—7·0	—8·0	..	..	..	.
„ 10	9 a.m.	—7·0	—7·8	..	—11·0	—20·5	—29
„ 14	9 a.m.	—2·0	—2·6	..	— 2·0	—11·0	— 22
	9 p.m.	0·5	0·0	..	..	..	..
„ 15	9 a.m.	—7·0	—7·4	..	— 7·0	—16·0	—29

* Said to have been —9° at Boston Spa, in Valley of Wharfe, 7 miles off.

"Taking then my own observations, so far as I think them worthy of credit, the lowest dew-point I have observed was on December 4th, 1879, at 9 p.m., viz. —2°·4. Next comes Christmas Day, 1860, when it was —0°·7 at 9 a.m. and —0°·2 at 3 p.m., having been —0°·3 at 3 p.m. on the 24th. Next we have January 17th, 1881, at 9 a.m. + 0°·3, the previous 9 a.m. showing + 0°·6. These were days on which very low temperatures were possible in suitable localities, and, as a matter of fact, were actually registered, although where I was the minimum was not below + 12° on the night of December 4th, 1879, + 11° on Christmas Day, 1860, and + 9° on January 16th, 1881. On the other hand, at 9 p.m. previous to the extreme frost of January 26th, 1881, the dew-point was as high as 6°·9, and thus, although the thermometer fell to —3° here and —13° in the valley close by, yet as the air was saturated and rime deposited on trees even here, the fog or frost-

haze over the plains was too dense to allow even an equal extreme of cold to be generally experienced there. May not the steadiness of the very low dew-point for at least 30 hours in December 1860, point to that as the frost which was the severest generally in low-lying places, though, on December 4th, 1879, there was a possibility of a yet lower temperature in some places? In all other respects the frost of 1860, being very severe only for one night, cannot be compared with those recently experienced.

"I should have liked to discuss the observations made by Colonel Ward, in December 1879 and January 1880, at Rossinières, but I have no means of working out dew points of 10° to 20° below zero. One cannot be surprised that the thermometer which, at my suggestion, he placed in a hollow place where cold air would be retained, as water is retained in heavy rains, (3½ feet above ground and protected from radiation), registered —37°, and that the average minimum for a week was —25°! I give, however, his figures at the foot of the preceding Table which I have drawn up.

"I have assumed the correctness of Glaisher's Tables. I could make nothing of M. August's formula. Could not the Society instruct Mr. Marriott to follow up his excellent Paper on the use of the Wet-Bulb Thermometer with a thorough examination of the numerous splendid observations which I believe Colonel Ward has taken, by which Mason's hygrometer could be compared with Regnault's, and Daniell's dew-point instruments, as well as with a Hair hygrometer for relative humidity? I have never used Mr. Dines's ingenious instrument, but even if available for low temperatures I should fear that the adhesion of air to its large flat surface will make the deposit of dew imperceptible, especially when the amount of vapour in the air is very small, till a point considerably below the dew-point is reached."

THE PRESIDENT (Mr. Symons) gave a verbal account of the snowstorms of January 17th to the 21st, when 12 inches fell over most of the South of England and upwards of 2 feet in the Isle of Wight and parts of Hampshire and Wiltshire.

Mr. BAKER said that he was somewhat sceptical as to such low readings as —16° and —22°, and thought that they should be received with caution, as he had known well-made thermometers be as much as 5° or 6° wrong at the lower parts of the scale.

Mr. C. HARDING suggested that for purposes of comparison a table might be given showing the number of days on which the mean temperature was below 32° with the average for the period, also the average of, say, the five coldest consecutive days, and the temperature of the coldest day. Such a Table formed from the Greenwich observations from 1813-1881, dealing with the frosts in which the daily mean temperature was below 32° on more than ten consecutive days, shows that, considering both intensity and duration, no frost since 1838 can be said to equal that dealt with by Mr. Marriott in the present paper. The following Table, drawn up from the Greenwich observations, may be interesting:—

Date.	No. of days with Mean Daily Temp. below 32°.	Mean Temp. for the Period.	Mean Temp. of five coldest consecutive days.	Lowest Daily Mean.	
				Temp.	Day.
		Jan. 26 days.			
1813, Dec. 26—1814, Jan. 26..	32	26°·2	° 21·9	° 19·6	10
1820, Jan. 3-18	16	25 ·4	20·4	14·6	15
1823, Jan. 9-26..	18	25 ·2	22·6	13·4	19
1829, Dec. 20—1830, Jan. 2 ..	14	26 ·0	24·6	23·5	27
1838, Jan. 8-21.....	14	21 ·1	19·5	10·7	20
1850, Jan. 6-16.....	11	29 ·4	27·9	25·5	15
1855, Feb. 7-23	17	26 ·0	23·3	21·1	18
1860, Dec. 18-29	12	27 ·7	26·0	20·2	25
1867, Jan. 12-22	11	26 ·4	25·5	19·3	14
1881, Jan. 12-27	16	24 ·4	20·0	18·5	15

He also drew attention to the fact that the winds over the North Atlantic during January this year were easterly, whereas they are generally south-westerly during that month.

Mr. ROSTRON said that the latest period of severe weather which he could find to compare with this one was in February 1855, which was known as the Crimean Winter. He had noticed that generally there were periods of cold in great frosts with a thaw at the end of about 15 days, and afterwards a recurrence of the cold weather. This was not a feature of the late frost, which, when the thaw came, departed once and for all.

Mr. SCOTT observed that the only day which he could remember as being in any way like January 18th was February 14th, 1870.

Mr. STRACHAN said that the thermometer at Blackadder should be verified at the melting-point of mercury. He remembered that it recorded —23° in December 1879, and that it was stated that the thermometer had been tested at the melting-point of ice. This was no assurance of accuracy at a low point of the scale, where the error might be very large.

Mr. GREAVES said that he well remembered the severity of the winter of 1838. Death occurred to many persons, and passengers were frozen on the tops of coaches. When laying water pipes in Lincolnshire during that season, he found that the frost had penetrated the ground of the street to the depth of 2 feet, so that work had to be suspended, it being useless to attempt excavation. He had never known a plain turnpike road frozen to a similar depth.

Mr. WHIPPLE said that at Kew some of the snow which fell on January 18th was still lying in a ditch not far from the Observatory.

The PRESIDENT (Mr. Symons) said that the thermometer at Blackadder was a Six's, and he had no doubt that at such a temperature as —22° it might be 5° or 6° out, but it must be borne in mind that the very best minimum thermometers are liable to as great an error, owing to the evaporation of spirit to the top of the tube. He believed that the liability to yield erroneously low readings was greater with Rutherford's thermometers than with Six's.

PROCEEDINGS AT THE MEETINGS OF THE SOCIETY.

JANUARY 19th, 1881.

Annual General Meeting.

GEORGE JAMES SYMONS, F.R.S., President, in the Chair.

Mr. J. W. PEGGS and Mr. H. S. WALLIS were appointed Scrutineers of the Ballot for Officers and Council.

Dr. TRIPE read the Report of Council and the Financial Statement for the past year. (p. 98.)

It was proposed by the PRESIDENT, seconded by Dr. TRIPE, and resolved:—"That the Report of the Council be received and adopted, and printed in the Society's Journal."

It was proposed by Mr. SCOTT, seconded by Mr. BREWIN, and resolved:—"That the best thanks of the Meteorological Society be communicated to the Council of the Institution of Civil Engineers for having granted the Society free permission to hold its Meetings in the rooms of the Institution."

It was proposed by Mr. EATON, seconded by the Rev. T. A. PRESTON, and resolved:—"That the thanks of the Society be given to the Officers and other Members of the Council for their services during the year."

It was proposed by Mr. BICKNELL, seconded by Mr. MELLISH, and resolved:—

"That the thanks of the Society be given to the Standing Committees and to the Auditors, and that the Committees be requested to continue their duties till the next Council Meeting."

The PRESIDENT then delivered his Address. (p. 65.)

It was proposed by Mr. LATHAM, seconded by Mr. FIELD, and resolved:—"That the thanks of the Society be given to the President for his Address, and that he be requested to allow it to be printed in the Quarterly Journal of the Society."

The Scrutineers reported the result of the Ballot, and declared the following gentlemen to be the Officers and Council for the ensuing year:—

President.

GEORGE JAMES SYMONS, F.R.S.

Vice-Presidents.

EDWARD ERNEST DYMOND.
WILLIAM ELLIS, F.R.A.S.
JOSEPH HENRY GILBERT, PH.D., F.R.S., F.C.S.
CHARLES GREAVES, M.Inst. C.E., F.G.S.

Treasurer.

HENRY PERIGAL, F.R.A.S.

Trustees.

SIR ANTONIO BRADY, F.G.S.
STEPHEN WILLIAM SILVER, F.R.G.S.

Secretaries.

ROBERT HENRY SCOTT, M.A., F.R.S., F.G.S.
JOHN WILLIAM TRIPE, M.D., M.R.C.P.E.

Foreign Secretary.

JOHN KNOX LAUGHTON, M.A., F.R.A.S., F.R.G.S.

Council.

EDMUND DOUGLAS ARCHIBALD, M.A.
ARTHUR BREWIN, F.R.A.S.
HENRY STOKES EATON, M.A.
ROGERS FIELD, B.A., M.Inst.C.E.
FREDERIC GASTER.
BALDWIN LATHAM, M.Inst.C.E., F.G.S.
ROBERT JOHN LECKY, F.R.A.S.
EDWARD MAWLEY.
HON. FRANCIS ALBERT ROLLO RUSSELL, M.A.
RICHARD STRACHAN.
GEORGE MATHEWS WHIPPLE, B.Sc., F.R.A.S.
CHARLES THEODORE WILLIAMS, M.A., M.D., F.R.C.P.

FEBRUARY 16th, 1881.

Ordinary Meeting.

GEORGE JAMES SYMONS, F.R.S., President, in the Chair.

ISAAC LOWTHIAN BELL, F.R.S., Rounton Grange, Northallerton;
JOSEPH BERNAYS, 96 Newgate Street, E.C.;
ALEXANDER WYNTER BLYTH, M.R.C.S., Court House, Marylebone, W.;

JABEZ CHURCH, M.Inst.C.E., F.G.S., 17B Great George Street, S.W.;
FREDERIC WILLIAM CORY, M.R.C.S., The Elms, Buckhurst Hill, Essex;
SAMUEL CUTLER, Providence Ironworks, Millwall, E.;
THOMAS L. K. EDGE, Strelley Hall, Nottingham;
CHARLES HORSLEY, 174 Highbury New Park, N.;
WILLIAM DILLWORTH HOWARD, F.I.C., Lord's Meade, Tottenham;
CHARLES KELLY, M.D., Broadwater Road, Worthing;
GEORGE LINGWOOD, 8 Cambridge Terrace, Southend;
WILLIAM MACGEORGE, Wynford Villa, Lessness Heath;
CAPT. JOHN PEARSE MACLEAR, R.N., H.M.S. 'Alert';
ARTHUR RIGG, 42 Old Broad Street, and
HENRY C. STEPHENS, F.C.S., Avenue House, Finchley, N.,
were balloted for and duly elected Fellows of the Society.

The following Papers were read:—

"Relative Humidity." By CHARLES GREAVES, M.Inst.C.E., F.G.S., F.M.S. (p. 132).

"The Frost of January 1881 over the British Isles." By WILLIAM MARRIOTT, F.M.S. (p. 138).

RECENT PUBLICATIONS.

ANNALES DU BUREAU CENTRAL MÉTÉOROLOGIQUE DE FRANCE, PUBLIÉES PAR E. MASCART, DIRECTEUR. Année 1878, Parts II. and IV. Année 1879, Parts I. and IV. 4to. 1880.

Part II. for 1878 contains the daily observations at 12 stations in France and 10 in Algeria, and the monthly results for 47 French and 33 Algerian stations. There is also a paper of 52 pages, by A. Angot, entitled 'Révue Climatologique mensuel pour la France et les contrées voisins pendant l'année 1878.' The value of this paper is greatly enhanced by 40 well executed maps showing for each month and the year the distribution of (1) pressure, (2) temperature, and (3) rainfall over the whole of the south-west of Europe.—Part IV., 1878, contains:—1. Etude sur la distribution relative à la surface du globe, des températures et des pressions moyennes pendant les mois de janvier et de juillet. 2. Etude sur la distribution des températures moyennes pour la portion du globe comprise entre les latitudes de 10° sud et 55° nord, et les longitudes de 18° est de Paris et 100° ouest pendant les mois de janvier et de juillet, par L. Teisserenc de Bort.—Part I., 1879, contains accounts of the storms in different parts of France during the year 1878, by M. Fron, M. Lespiault, M. A. de Pons, and M. Plumandon. Also the following memoirs:—1. Températures du sol et de l'air observées au Muséum d'Histoire naturelle pendant l'année 1878, par E. et H. Becquerel (11 pp.). 2. Sur les observations pluviométriques faites dans la Neustrie (plaine de la France septentrionale) de 1688 à 1870, par V. Raulin (21 pp.). 3. Les phénomènes périodiques de la végétation d'après les travaux des météorologistes scandinaves, par Ch. Flahault (15 pp.). 4. L'Héliophotographie appliquée à la prévision du temps, par C. V. Zenger (26 pp.). 5. Tables pour calculer les hauteurs au moyen des observations barométriques, par A. Angot (23 pp.). 6. Le Verrier météorologiste, par L. Brault. (9 pp.).—Part IV., 1879, contains:—Théorie de la circulation atmosphérique, par M. de Tastes (18 pp.). Etude de la circulation atmosphérique sur les continents, par L. Teisserenc de Bort (42 pp.). Nouvelles récherches sur le Climat du Sénégal, par Dr. A. Borius (31 pp.).

ANNUAIRE DE LA SOCIÉTÉ MÉTÉOROLOGIQUE DE FRANCE. 28me Année. 1880. 3me Trimèstre. 4to.

Principal contents:—La climat de la Bretagne, par E. Bouvet (36 pp.).—Compensation des baromètres anéroïdes, par E. Renou (2 pp.).—Tables

nouvelles pour mesurer les hauteurs au moyen des observations barométriques, par A. Angot (11 pp.).

BEHM'S GEOGRAPHISCHES JAHRBUCH. Vol. VIII. 8vo.

Contains:—Bericht über die Fortschritte der geographischen Meteorologie, von Prof. Dr. J. Hann (pp. 146). This is the biennial *résumé* of the progress of Meteorology in various parts of the world for the years 1878 and 1879.

CIEL ET TERRE. REVUE POPULAIRE D'ASTRONOMIE ET DE MÉTÉOROLOGIE. February to April 1881. 8vo.

The chief meteorological articles are:—L'Aurore boréale du 31 Janvier 1880 (7 pp.).—La pluie en Belgique pendant le mois de Décembre 1880, par A. Lancaster (6 pp.).—La force du vent en Belgique, par F. Van Rysselberghe (5 pp.).—La théorie des cyclones (11 pp.).—Sur un phénomène particulier observé pendant la chute du grésil, par M. Melsens (4 pp.).—La commerce maritime et la météorologie, par F. Van Rysselberghe (10 pp.).—La question du grisou, par A. Lancaster (5 pp.).—De la nécessité de créer en Belgique un, ou plusieurs, services hydrométriques, par A. Lancaster (12 pp.).

JOURNAL AND PROCEEDINGS OF THE ROYAL SOCIETY OF NEW SOUTH WALES. 1879. Vol. XIII. 8vo.

Contains a paper on the 'Wentworth' hurricane, January 10th, 1879 (10 pp.); and an abstract of the meteorological observations taken at the Sydney Observatory during 1879 (12 pp.), both by H. C. Russell, B.A.

JOURNAL OF THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND. Second Series. Vol. XVII. Part I. No. XXXIII. 8vo. 1881.

Contains:—Remarks on the recent Conference at Vienna on Agricultural and Forest Meteorology, by R. H. Scott, F.R.S. (20 pp.).—On the Amount and Composition of the Rain and Drainage-Waters collected at Rothamsted, Parts I. and II. By J. B. Lawes, LL.D., F.R.S., J. H. Gilbert, Ph.D., F.R.S., and R. Warrington (38 pp.).

ON A STORM SAILING GUIDE FOR THE NORTH ATLANTIC. By HUGH V. PAYNE, INSPECTOR, METEOROLOGICAL SERVICE, CANADA. 8 pp. with two Photographs. 8vo. 1881.

The guide is intended by a simple movement to clearly inform captains of vessels, in whatever part of the North Atlantic they may be, in what direction a storm's centre is situated from the ship, in what direction the storm is moving, and in what direction it would be most advisable to sail to get out of dangerous proximity to it, or how to make use of it by sailing on its outer edge or in its wake.

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY. Part III. 1880. 4to.

Contains:—On the Determination of the Constants of the Cup Anemometer by Experiments with a Whirling Machine. Part II. By T. R. Robinson, D.D., F.R.S. (16 pp.).

PROCEEDINGS OF THE ROYAL SOCIETY OF EDINBURGH. Session 1879-80. 8vo. 1880.

Contains:—On the distribution of Temperature under the ice in frozen Lakes, by J. Aitken (6 pp.).—Researches in Thermometry, by E. J. Mills, D.Sc., F.R.S. (3 pp.).—Notice of the completion of the new Rock Thermometers at the Royal Observatory, Edinburgh, and what they are for, by Prof. Piazzi Smyth (1 p.).

REPORT OF THE FOURTH CONGRESS OF THE SANITARY INSTITUTE OF GREAT BRITAIN, HELD AT EXETER, SEPTEMBER 1880, being Volume II. of the Transactions. Editors:—H. C. Burdett and F. de Chaumont, M.D., F.R.S. 8vo. 1880.

The only meteorological papers read at the Congress were:—Address of the President of Section III. on Meteorology and Geology, by Sir Antonio Brady (26 pp.).—Some Deficiencies in our Knowledge respecting Health Resorts, by G. J. Symons, F.R.S. (8 pp.).

REPORT OF THE MARLBOROUGH COLLEGE NATURAL HISTORY SOCIETY FOR THE YEAR ENDING CHRISTMAS 1880. No. 29. 8vo. 1881.

Contains a paper on Wind and Weather, by the Rev. G. C. Bell (6 pp.); and in an appendix are given the daily observations and a summary of the weather, with a meteorological chart for the year 1880.

SITZUNGSBERICHTE DER KAISERLICHEN AKADEMIE DER WISSENSCHAFTEN. Band LXXXIII. Feb.-März Hefte. 1881. 8vo.

Contains two papers by Dr. J. Hann, viz. (1) Ueber den täglichen Gang einiger meteorologischen Elemente in Wien (Stadt), (27 pp.); and (2) Ueber den täglichen Gang des Luftdruckes, der Temperatur, der Feuchtigkeit, Bewölkung und Windstärke auf den Plateaux der Rocky Mountains (20 pp.).

THE SCIENTIFIC ROLL AND MAGAZINE OF SYSTEMATIZED NOTES. Conducted by ALEXANDER RAMSAY, F.G.S. Climate. Vol. I. Part 1. No. 2. 32 pp. 8vo. 1880.

Contains an Essay on the connection between Solar Phenomena and Climatic Cycles, by Prof. E. D. Archibald, and also a General Bibliography of meteorological works arranged chronologically between 1831 and 1854.

THE WEATHER OF 1880 AS OBSERVED IN THE NEIGHBOURHOOD OF LONDON, AND COMPARED IN ALL RESPECTS WITH THAT OF AN AVERAGE YEAR. By EDWARD MAWLEY, F.M.S. With Tables of Daily Observations and a Diagram. 68 pp. 8vo. 1881.

This gives a summary of the weather at Addiscombe, near Croydon, for each month, together with tables of daily observations, which are compared with the Greenwich averages of 39 years. The year 1880, taken as a whole, may be described as having been of average temperature, very wet, and rather dull, with a windy and humid atmosphere.

ZEITSCHRIFT DER OESTERREICHISCHEN GESELLSCHAFT FÜR METEOROLOGIE. Redigirt von DR. J. HANN. XVI. Band. February to April, 1881. 8vo.

Contains:—Rykatchew über den täglichen Gang des Barometers (12 pp.).—Ueber den Ursprung des Mistral, von O. Dersch (5 pp.).—Zur Anwendung des Princips der Flächen in der Meteorologie, von Dr. A. Sprung (7 pp.).—Die verticale Temperaturvertheilung innerhalb barometrischer Maximal-Gebiete zu verschiedenen Jahreszeiten, von R. Billwiller. (6 pp.).—Ueber den täglichen Gang der Temperatur zu Hamburg an heiteren Tagen, von O. Jesse (5 pp.).—Ueber den Zusammenhang zwischen der terrestrischen Strahlenbrechung und den meteorologischen Elementen, von H. Hartl (12 pp.).—Ueber mehrjährige Perioden der Witterung, von Dr. W. Köppen (10 pp.).

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A CONTRIBUTION TO THE HISTORY OF HYGROMETERS.

By G. J. SYMONS, F.R.S., President.

[Read March 16th, 1881.]

I NEVER feel sure how far back it is desirable to go in tracing the history of Meteorological Instruments or Meteorological Phenomena. I think it was Professor Daniell who went back to Pliny, and brought him up as the earliest observer of the dew-point. I give the passage, and leave the Fellows to form their own opinions respecting it:—"Nec non in conviviis mensisque nostris vasa quibus esculentum additur sudorem repositoriis linquentia diras tempestates prænuntiant."—*Nat. Hist.* Lib. XVIII. Perhaps, however, I may as well quote also the somewhat verbose old translation given by Daniell:—"Whensoever you see at any feast the dishes and platters whereon meat is served up to the board sweat or stand of a dew, and leaving that sweat which is resolved from them either upon dresser, cupboard or table, be assured that it is a token of terrible tempests approaching."

This was not the only hygrometric effect noticed and used as a weather sign. I have not had time to look carefully for such cases but may quote one from Mizaldus, published in 1554:* he says:—"Musicorum instrumentorum subtensae fidiculae ruptim dissilientes, et hostia absque manifesta causa, aperiri claudique solitò contumaciora, aerem pluvias nobis miscere palam nuntiant." If that is not an early illustration of the catgut hygrometer, I do not know what is.

Before commencing my chronological notes upon the instruments, I wish to mention briefly the various names given to what are now in this

* Mizaldus A. Ephemerides Aeris Perpetuae. Sm. 8vo. Lutetiae 1554.

country always known as hygrometers. The earliest name was, I believe, Notiometers, from the Greek Νοτίς, *dampness*, and Μέτρον, *measure*; but Hygrometer, from Ὑγρός, *damp*, and Μέτρον, *measure*, has been in use more than two hundred years, having been first suggested by the celebrated mathematician Lambert. Then there is Hygroscope, Ὑγρός, *damp* and Σκοπέω, *to look at* which, of course, implies an indicator of moisture which the instrument is not accurate enough to measure. Lastly, there is the abominable word Psychrometer, said to have been applied to the wet-bulb thermometer by August in 1831; but *if* August invented the word he must have done so at an earlier date, for J. G. Greiner published, at Berlin, in 1825, an 8vo pamphlet entitled' Ueber das Psychrometer.' Psychrometer is derived from Ψυχρός, *cold*, and Μέτρον, *measure;* a very appropriate name for a minimum thermometer, but, in my opinion, unsuitable for a dry and wet.

One other prefatory remark. The preparation of this paper came upon me partly by surprise, amid such a pressure of work as I have never had before. I do not wish to burden the paper with constant repetitions of such phrases as "I believe," "I think," "it seems," and so on. I therefore purpose stating throughout, as actual facts, the best information which I have been able to obtain; but as I have had to write very rapidly, and to translate from several languages with which I am not familiar, I have merely called the paper "A Contribution to the History of Hygrometers," and shall rejoice as much as any one to see my "contribution" corrected and worked up by some one with leisure, into a perfect history.

I have, after much consideration, resolved on a merely chronological arrangement. Originally I thought of taking, as is done in several treatises on Physics, the classification first suggested by Pouillet, viz. :—

1. Hygrometers (or Hygroscopes) of absorption.
2. ,, of Condensation, *i.e.* dew-point instruments.
3. ,, of Evaporation, *i.e.* dry and wet-bulb thermometers.
4. Chemical Hygrometers, for determining the amount of vapour by analysis.

But I gave this up when I found that many instruments were on the boundary lines of the classes, and some almost entitled to be in more than one; and also because, by thus dividing the instruments, I was unable to trace clearly the progress of the subject at large.

The only difficulty in the chronological arrangement has arisen from the fact that our predecessors were not very methodical in recording the dates of inventions, and hence, in several cases, the only course has been to assign to a pattern of instrument the date of the publication of the first book in which I have been able to find a mention of it. This again has led to much trouble, because it is so rare for authors when quoting a work to give its date that, in nearly all cases, it has been necessary to consult the original book in order to ascertain the date.

Mersenne, 1644, is sometimes quoted by French writers as the first to use a hygroscope, but this is incorrect, I have already shown that all that he did

Mizaldus had done ninety years before, viz. noticed that the pitch of the strings of a violin varied according to the dryness of the air.

Anonymous, 1660?—This was a dew-point instrument made more than two centuries since, by the Members of the Accademia del Cimento, some of whose exquisite instruments the Fellows may have seen in the Loan Collection at South Kensington in 1876. It consisted of a tripod, carrying a funnel shaped glass, into the upper portion of which was fitted a tin cylinder lined with cork; the lower orifice of the glass funnel was closed, but in its side there was an outlet pipe. The vessel, both the cork lined cylinder and the conical glass into which it fitted, being filled with pounded ice, the surface of the glass became very cold, and the vapour condensed on the outside of the glass dropped from the point into a divided jar placed below to receive it. The observations were made by noticing the quantity condensed during successive minutes. The water resulting from the melting of the ice was kept quite separate by means of the tube, and was of course thrown away.

Hooke, R., 1664.—Hooke, in his *Micrographia*, says that he had tried to make a hygrometer of catgut, but that was not so good as the beard of a wild oat, and he proceeds to describe and give engravings of a complete oat-beard hygrometer. The beard was to be fixed firmly at the base, it was to pass through a hole in the centre of a dial, and to its top was to be fastened a light index hand of black paper. As the beard curled or uncurled according to varying humidity, the index pointed over the various divisions on the dial.

Hooke concludes by remarking that the beard of the Musk Grass or *Geranium moschatum* is better for the purpose than that of the wild oat.

I may add that daily observations of one of these hygrometers at Oxford, commencing with July 30th, 1666, are printed in full in the *General History of the Air*, by the Hon. Robert Boyle.

Cusano, 1670?—Previous to 1670 Cardinal Cusano used a pair of scales, one pan containing a dried flake of cotton or of silk, and the other brass weights which counterpoised it when dry; of course, as the cotton absorbed moisture the pan containing it became the heavier.

Conlers, 1670, utilised the lateral expansion of wood by moisture. He provided a frame in which were contained two panels of wood; they could only swell towards the centre, where there was an open space between them; one carried a horizontal rack, the other a toothed wheel with an arrow on its axle—as the boards approached, the rack turned the toothed wheel, and so the arrow was turned in one direction, and when the boards dried and separated, the arrow was turned in the opposite direction.

Lana (1), 1670, refers to the oat-beard hygrometer, but prefers to use part of a convolvulus stem. He fastened it vertically at the bottom of a little tube or vase—round the rim of the vase he placed a divided circle—on the top of the convolvulus he put a light figure of a man with a spear, and as the stem twisted, the spear pointed to a greater or less degree of moisture.

Lana (2), 1670, also shows a neat application of the well-known fact that ropes become shorter when wet. He had two separate ropes, two upright

beams, two wheels, and two bells with hammers to them. The differences were that one bell was of a different tone to the other, and that the two ropes went round the pullies in opposite ways. The result was that when the ropes were shortening a series of strokes was produced on one bell, and when they were lengthening the other bell was struck.

Lana (3), 1670, substituted in the pan of Cusano's scale, in lieu of cotton or silk, salt, calcined saltpetre, and similar substances.

Foucher, 1672.—Having noticed the variations in the tension of drums, Foucher first tried parchment. He took a strip about 6 inches long, fastened it at both ends, rested upon it the short arm of a balance and on the long one put a quill pen which moved up and down, and so showed on an enlarged scale the shrinking of the parchment.

Afterwards he tried catgut, but rejected it; and finally adopted a set of strips of sheepskin prepared with vinegar and sal ammoniac, attached to each other so as to make one long band running over many pullies, and finally turning a hand over a graduated dial.

To about this date are due two items which may as well be disposed of at once. The first is *why* ropes become shorter when wet. It is very obvious when one thinks about it, but I have never seen it so clearly explained as in Dr. Papa's Italian Book, published in 1681, where he gives an engraving showing particles of water entering between the fibres of the rope and thereby increasing its circumference, and therefore obviously decreasing its length.

The other digression is a story (very likely a true one, for Fontana was a capital hydraulic engineer) respecting the erection for Sixtus V., of the Obelisk (the Cleopatra's Needle of the day) in front of the Cathedral of St. Peter's at Rome. Dalencé says that the column having been pulled by ropes *nearly* upright, it was found that the capstans could not be wound any further, when Fontana, the architect, ordered the whole of the ropes to be thoroughly wetted, and thus they became short enough to bring the column upright.

Anon (Nuremberg), 1681 ?—The members of the experimental Academy at Nuremberg added to the pair of scales, used by Cusana and Lana, a divided arc in order to read off the amount of increase; but they divided the arc into equal divisions, and as the index does not move through equal arcs for equal increments this arrangement cannot be much praised.

Gould (1), 1683, proposed utilising the affinity which exists between sulphuric acid and water, as a measure of the amount of vapour present in the air. His arrangement merely consisted of a pair of scales, with a cup of sulphuric acid in one pan and brass weights in the other.

Gould (2), 1683.—Gould also made a hygrometer with a long violin string, which he fixed at one extremity and carried backwards and forwards over a series of pulleys, loading the other end with a bullet, and attaching to the last pulley an index, which travelled over a graduated arc according as the string lengthened or shortened.

Molyneux, 1685, took a piece of whipcord, fastened it at the top, loaded it with a weight of 1 lb., attached an index to the bottom and left it to twist and untwist over a graduated card.

Dalence, 1688.—In his *Traittez*, published in 1688, Dalencé describes many forms of notiometers, but I have already shown to whom nearly all are due; the only one mentioned by him, and which I have not yet traced, is, I fancy, due to the Hon. Robert Boyle. It is a steelyard, the extremity travelling over a graduated arc, and the pan being loaded with a sponge partly saturated with a solution of sal ammoniac.

Fontana, 1696.—I have two slightly different reports as to what was done by this engineer, whom I have already mentioned. La Rousse, in his *Grand Dictionnaire Universel*, says that Fontana noticed the increase in the weight of a glass of cold water arising from the condensation of vapour on the outside. Saussure, in his *Hygrométrie*, says that he took a polished plate of glass, dried it and weighed it, then cooled it to a certain temperature, and weighed again, the excess showing the amount of vapour condensed.

Musschenbroek, 1731, did not invent a hygrometer, but, in his French edition of the Experiments of the Accademia del Cimento, he inserts a note respecting their observations upon the vapour condensed by their cold funnel, that it would produce a current of air towards it, and that, therefore, it would have been better to have made the experiment upon a given quantity of air shut up in a box.

To about this date are to be ascribed two patterns, I will not say of hygrometers, but of Damp Indicators, one of which is still in use—viz. the so-called Dutch "Weather House"—why called Dutch I do not know, for I cannot trace its history; it was well known in 1735; I believe it was not known in 1680. It is merely a handy form of catgut hygrometer.

The other I only know of from our late President, Mr. Greaves, who told me that in Brewster's *Natural Magic* there is a description of a figure of a horse so made of wood, that by its alternate expansion and contraction, the horse would walk across a room. I have Sir David's book, but have not yet found the description—such a thing is, however, evidently mechanically possible.

Dalibard (1), and Du Hamel, 1737.—In the *Mémoires de l' Académie de France* for 1744 are notes of experiments made by both Dalibard and Du Hamel as to the variation in the weight of blocks of various woods dependent upon their hygrometric state, but neither seems to have proposed any complete form of instrument.

Dalibard (2), 1744 ?—About seven years later Dalibard brought out a rather good pattern of catgut hygrometer. It consisted of a brass tube pierced with many holes and about 6 inches long. To the bottom of it was attached a piece of catgut, and the variations in its twist were shown upon a graduated circle at the top.

Desaguliers, 1744, modified the sponge hygrometer, hanging it by a cord from a wheel cut fusee-wise, so that the irregularity in the sensitiveness of the sponge might be neutralised.

Pickering, 1744.—The sponge hygrometer modified, by cutting the sponge in a thin slice so as to expose a large surface.

Arderon (1), 1745.—Another slight modification of the sponge hygrometer.

Arderon (2), 1745.—Modification of the rope hygrometer.

Arderon (3), 1746.—An arrangement for observing the variation in the length of a rod of wood cut transversely to the grain.

Le Roy, 1751.—This consists of a tin vessel containing water, in which a thermometer is immersed. The temperature of the water and containing vessel is gradually lowered by the introduction of ice, and when it has fallen below the dew-point of the adjacent air, a portion of the vapour will be condensed as dew upon the exterior of the vessel. This is at once recognised by the metallic surface losing its brilliancy. Prof. Everett makes the following comments upon this instrument—comments which apply to many other patterns:—

"We may observe that the deposition of dew does not begin till the point of saturation has been passed, and that the indication of the thermometer is consequently somewhat too low. Le Roy proposed an empirical correction of half a degree. There are, however, other defects in the instrument; the use of ice does not afford a speedy and regular diminution of temperature, and it is especially objectionable to place an open vessel containing water in the very place where the humidity of the air is to be determined."

This is said to be quoted from the *Mémoires de l'Académie de France* for 1751, but I do not see it mentioned in Le Roy's article. He, however, mentions having used a series of wine glasses, pouring very cold water into one and of course obtaining a deposit of dew, then emptying it into others successively until no dew was deposited, and then noting the temperature—a process adopted as new by Daniell 61 years afterwards! Saussure, in describing the vessel with the thermometer immersed in it, says that it was glass, not tin. Le Roy may be regarded as the first who determined the dew-point with a view to hygrometrical results.

Ferguson, 1764.—A modification of the wooden panels used by Coniers in 1670.

Lambert, 1768.—This was a catgut hygrometer made precisely on the pattern of Hooke's Oat-beard instrument of 1664.

Smeaton, 1771.—An arrangement for observing the varying length of a cord, with an adjustment for correcting for the gradual loss of sensitiveness.

De Luc (1), 1773.—This was perhaps the earliest hygrometer worthy of the name of a scientific instrument. It consisted of an ivory cylinder rather more than an inch long and about a quarter of an inch in diameter, closed at one end and at the other fitted on to a thermometer tube. The cylinder and part of the tube being filled with mercury, any variation produced, by changes in the humidity of the air, in the size of the cylinder caused a great movement in the column of mercury in the bore of the thermometer.

Buissart, 1774.—This was similar in general principle to the ivory hygrometer of De Luc, but the tube of a goose quill was used instead of the ivory.

Inochodzoff, 1776.—This author, on visiting Kamschatka, found a schistose rock having remarkable power of absorbing and yielding up humidity. He determined the extremes of his scale by saturating the stones and weighing them, then by making them red-hot and re-weighing them.

Cullen, 1777, ascribes the cooling of a wetted thermometer to evaporation. He says, "I think we may now conclude that *the cold produced is the effect of evaporation.*"

Retz, 1777.—Almost identical with Buissart's quills.

Sennebier, 1777.—A very delicate balance with a glass pan 1½ inch in diameter loaded with salts of tartar.

Desjardins, 1778.—Merely a modified catgut hygrometer.

Copineau, 1780, suggested a slightly different mode of using goose quills from that adopted by Buissart and Retz.

Saussure, 1780.—Although the literature respecting Saussure's hair hygrometer far exceeds a thousand pages, the essential features may be very briefly stated:—Saussure found that an ordinary human hair between the two extremes of saturated, and of perfectly dry, air varies one forty-second part of its length. He also found that its uniform action in this respect is materially impaired if the hair is not thoroughly freed from grease. These general principles having been ascertained, it only remained to discover the best mode of preparing the hair, the best mechanical arrangement for rendering visible the variations of length, and the best means for determining the two fixed points of the scale, the 0 of absolute dryness, and the 100 of saturation. The arrangement generally adopted by Saussure was, a brass frame with a hair about 7 inches long, fastened at one end by an adjustable screw and at the other attached to the short arm of a lever, of which the long arm travelled over a graduated arc. A counterpoise weight was used to keep equal tension upon the hair, and various contrivances were employed to prevent the hair becoming loose or deranged during transport.

De Luc (2), 1781.—De Luc, after trying many substances, decided that that which on the whole seemed to yield the most uniform and satisfactory results was a strip of whalebone cut transversely to the fibre. He originally used strips about 8 inches long and $\frac{1}{10}$th of an inch wide, fixed firmly in a brass frame at one end, and at the other carried round a small wheel to the axle of which a pointer travelling over a divided arc was attached. The whalebone was kept in tension by a slight spring.

Laurian, 1782.—This was a sheet of paper attached to one arm of a balance; as the paper absorbed moisture it is obvious that its weight increased.

Chiminello (1), 1783, proposed the use of a strip of gold beater's skin instead of hair in Saussure's hygrometer.

Lovitz, 1783.—In the year 1772 Lovitz found, at Dmitriefsk on the banks of the Volga, a schistose stone so porous that when saturated it weighed nearly half as much again as when dry. This he, twelve years afterwards, proposed should be utilised for hygrometric purposes. There seems to me to be some confusion respecting the invention of this form of hygrometer—it will be seen to be identical with one already described in 1776 by Inochodzoff.

Schreber, 1783.—This was a proposal to hang a stone called "hydrophanus" on a balance, but nothing is said as to how the extremes of dryness and of moisture were to be ascertained, or how the scale was to be laid off.

Chiminello (2), 1784.—This was a slight and injudicious modification of Saussure's hair hygrometer, more easy to read, but inaccurate, because the tension upon the hair was rendered unequal.

Huth, 1784, proposed to utilise the skin of a frog.

Baptista (1), 1785.—J. Baptista, who was a Capuchin Friar at St. Martin's at Vicenza, proposed an instrument compounded of that of Chiminello, viz. gold beater's skin, and which he attached to the periphery of a wheel carrying a long index. The weight of this index supplied the necessary tension. This was evidently a bad plan, as the leverage would vary according to the position of the hand.

Baptista (2), 1785.—The same mechanical arrangement as that just described, but worked by a hair.

Bjerkander, 1785.—This can hardly be called even a hygroscope, still less a hygrometer. Bjerkander advised that a dried specimen of *carlina vulgaris* should be carefully watched, as it closes in dry weather and opens in wet.

Chiminello (3), 1785.—In 1784, the Academia Theodoro-Palatina offered a premium for the best hygrometer, and awarded it to Chiminello for one sent in by him, which consisted of a goose quill attached to a thermometer-tube. But it was not at all new; it had been proposed eleven years earlier by Buissart, and had been tried by Retz, Copineau, and De Luc.

De la Guerrand, 1785, proposed to thoroughly dry some sea-weed, to place it in one pan of a pair of scales and record the variation in the weight.

De Luc (3), 1786, proposed a modification of his whalebone hygrometer, in which the strip passed round six wheels, in that way rendering the instrument circular, and not much larger than a watch.

Cazalet, 1786, proposed to use a single fibre of unspun silk, very much in the same way as Saussure had used hair.

De Luc (4), 1788, brought out another pattern for very accurate observations, in which the end of the whalebone was attached to a vernier.

Richeus, 1789, proposed a modification of Saussure's hair hygrometer, using eight hairs instead of one, but as they were all attached to one bar, it would seem that the indication must always have been that of the shortest individual hair, the others remaining slack.

Coventry (1), 1790? attached graduated cards to a length of catgut hung vertically; one card was fixed at one-tenth of the total length from the top to the second, which was at the base and just above the tension weight. A vertical catgut ran down the board, from which the line was suspended and acted as a zero line.

Coventry (2), 1790?—A specimen of this instrument, made by George Adams (about 1790?), is still preserved by the authorities of King's College, and belongs to the Museum of George III. It consists of a number of discs of thin paper (perhaps once saturated with salt) on a thread attached to the short end of a lever, the long end of which points to a higher or lower division on the scale, accordingly as the weight of the paper (by absorbing moisture from the air) increases or decreases.

Polius, 1790? used a hempen cord.

Rabellio, 1790? used swan's quills instead of those of geese, as employed by Buissart and others.

Mann, 1790.—This was a suggestion rather than an instrument. Mann having noticed that the number of revolutions of a cylinder electrical machine requisite to obtain a spark varied with the humidity of the air, suggested that it was possible by having the machine always turned at a uniform velocity and by counting the revolutions, to determine the amount of vapour present in the air.

Volta, 1790.—This was also a suggestion for utilising electrical values. It was proposed to charge an electrometer up to a certain number of degrees, and to notice how long it was before the air carried off the whole charge.

Hutton, 1792, used a moistened bulb thermometer in order to ascertain the humidity of the air.

Barbosa, 1797.—The principle of the old Oat-beard hygrometer, but that of the *Geranium moschatum* used instead. That is to say, he brought out as new what Hooke had used 188 years previously.

Hochheimer, 1797.—This was similar to Inochodzoff's and Lüdicke's stone hygrometer in general form, but he used a slab of ground glass about 10 inches by 7 inches; the extremes were found by dipping in water, draining and weighing, then by drying in hot ashes and re-weighing. This also much resembles one of Le Roy's methods.

Ludicke (1), 1799, proposed that instead of Saussure's arrangement, whereby the hair pulls directly at the short end of a lever, working in a bearing, all friction should be avoided by making it pull upon one side of a balance supported only by two fibres of silk. Excessively delicate as this arrangement was, it would be impracticable to move the instrument about, and without extreme care in construction it would put a variable tension upon the hair.

Ludicke (2), 1799, proposed that the indications of Lovitz's slate hygrometer should be obtained by suspension from a frictionless balance, such as he had suggested should be applied to Saussure's hair hygrometer.

Leslie, 1799.—This is an application of Prof. Leslie's differential thermometer. A glass tube, bent siphon fashion, is fixed with the bend downwards, each upper extremity terminates in a hollow bulb. The tube contains rather more than enough coloured sulphuric acid to fill the whole of one leg. But one of the bulbs is to be of blue glass, the other is to be covered with wet muslin, like a wet-bulb thermometer; the result of the cooling thereby produced is to cause the air in that bulb to contract, and the liquid to rise in the vertical tube, of which it is the terminal. Hence the readings indicate the rate of evaporation.

Monnier, 1800?—This was the application of the same principle to the hair hygrometer of Saussure as the modification of his whalebone hygrometer suggested by De Luc in 1786. Monnier suggested that the hair should be fastened at one end and pass over four pulleys, three forming the angles of an equilateral triangle, and the other in the centre and carrying the index-needle. This made the instrument both small and portable.

Seiferheldius, 1800.—Very similar to De Luc's whalebone hygrometer, but the active agent was a strip cut longitudinally from a goose quill.

Forster, B.M., 1801.—Oat-beard hygrometer, with the beard horizontal and made to wind up a pea at the end of a silk thread: which I should describe as Hooke's hygrometer spoiled.

Dalton, 1802.—This can hardly be called a hygrometer, but it is right under this date to mention that Dalton in this year determined the dew-point by taking a cylindrical glass vessel, filling it with cold water, and repeatedly wiping the outside dry until water ceased to be deposited upon it, and then noticing the temperature of the water contained in it.

Boeckmann, 1802.—We have seen that Cullen, in 1777, ascribed the cooling of a wetted thermometer to evaporation. Boeckmann went further, and in 1802 (about seven years before Dr. Mason, to whom so many people ascribe the dry and wet-bulb hygrometer; seven years, I say, before Mason was born) Boeckmann was making, at Carslruhe, two observations each day of Leslie's hygrometer for comparison with the readings of a dry-bulb thermometer and one surrounded by gold beater's skin and dipped in water. That there may be no further doubt upon the subject, I give the words as they stand in August's *Ueber die Fortschritte der Hygrometrie*, published in 1830,—which was itself six years before Mason's paper appeared,—and also a rough translation:—

"Die frühesten Psychrometer-Beobachtungen sind in Carlsruhe vom Prof. Boeckmann, im Sommer 1802, zwei Tage hindurch zur Controlle des damals neuen Leslie' schen Hygrometers angestellt worden. Der Beobachter hatte die Kugel des einen Thermometers mit Goldschlägerhäutchen umgeben und in Wasser eingetaucht. Unter den wenigen Beobachtungen, welche Boeckmann in dieser Art anstellte, findet sich eine recht interessante. Am 27 Juli 2¼ Uhr Nachmittags beobachteter zwischen dem trockenen und feuchten Thermometer eine Differenz 21°·5 — 13°·7 = 7°·8 R."

"The earliest psychrometer observations were made at Carlsruhe, by Prof. Boeckmann, in the summer of 1802, for two days' successively for comparison with the then newly erected Leslie hygrometer. The observer had the bulb of one thermometer surrounded with gold beater's skin, and dipped it in water. Among the few observations which Boeckmann made on this system there is one of much interest. On the 27th of July, at 2.15 p.m., the readings were, dry-bulb 80°·4, wet-bulb 62°·8, difference 17°·6 Fahr."

Ludicke (3), 1802.—This is a pattern of dry and wet-bulb which I do not quite understand. There were two thermometer tubes—one had a bulb spherical, as usual—the other had a double hemispherical or cup shaped bulb at the end of a curved tube, and it was attached to a sliding scale, so that the hollow cup, which was filled with water, could be brought up to fit the other bulb.

Perricot, 1802.—An improvement upon Chiminello's goose quill hygrometers, so far as relates to the fixing of the zero of absolute dryness.

I.R.I. (in Nicholson's Journal), 1804.—A correspondent, writing from Edinburgh with the initials I.R.I., suggested that the variation in the weight

of a quantity of oxide of cobalt, popularly known as "Royal Smalts," would be a useful measure of the hygrometric state of the air.

Berzelius, 1808, encased the bulb of a thermometer in polished steel, and having cooled it, noticed at what temperature dew ceased to be deposited upon it.

Conversinius, 1808.—The last cord hygrometer which need be mentioned, and, rather curiously, it was designed to effect in a different manner precisely the same object as Lana's in 1670, viz. to strike bells of different tones according as it lengthened or shortened.

Guyton de Morveau, 1808.—This was a repetition of Gould's arrangement proposed 128 years previously, viz. the variation in the weight of a cup full of sulphuric acid, but Guyton de Morveau tried also chloride of calcium.

Gough, 1809.—The most delicate and accurate of all the forms of *wood* hygrometer. It consisted of a metal frame of which three sides were straight and the angles right angles—the inclination of the fourth side is to be determined as follows. Take a rod of wood, cut across the grain, about 5 inches long and a quarter of an inch thick, saturate it and mark its extreme length on one of the two sides of the frame; then dry the wood by exposure to unslacked lime and lay off its length on the other side—join this point to the terminal when saturated. This will produce a frame gradually diminishing in length from its base to its top—mark 100 at the base, 0 at the top, and divide the intervening space equally. Then at any time by applying the rod to the frame, and seeing what part its length fits into, the value opposite would give the degree of humidity.

Van Mons, 1809.—This was the first application of sulphuric acid to a thermometer. Van Mons moistened the bulb of a thermometer with sulphuric acid, and noticed how much it was thereby heated—but he seems to have experienced much difficulty in obtaining acid of uniform specific gravity.

Kater, 1809.—The active agent in this hygrometer is a twisted filament of the Indian grass (*Andropogon contortum*). It was graduated from 0 to 1000, 0 being laid off when the instrument was immersed in unslacked lime, and 1000 when saturated with moisture. A specimen of this instrument is still in existence, being among the collection belonging to the Royal Society.

Soldner, 1809.—This is believed to be the first employment of sulphuric ether, and Soldner the first observer who noted both the temperature at which dew was formed and at which it disappeared. The instrument seems to have consisted of a large thermometer with a flat disc-like bulb, one side of black glass, the other was to be wetted with ether, and the temperature was to be read both when dew was first seen and when it vanished.

Daniell (1), 1812, used half-a-dozen glasses, just as Le Roy had done 61 years before.

Leslie (2), 1813.—This was almost identical with De Luc's ivory cylinder hygrometer of 1773, the only difference being that Leslie used an elongated spheroid, about 1¼ inch long, instead of a cylinder.

Burrhard, 1816.—The piece of sponge on a balance—quite 150 years after its first use.

Wilson, 1816.—Similar to De Luc's of 1773, but instead of the ivory cylinder, a rat's bladder was to be used. This grand idea was patented.

R. G[ordon] of K[infaun]s, 1817.—A writer in Blackwood's Magazine, whose initials and residence agree with that of one of the best observers of the day, Mr. R. Gordon, of Kinfauns, after describing Leslie's hygrometer, says, "I took two thermometers as nearly alike as possible, suspended them about 2 inches apart, covered one with blue silk and with filaments of floss silk leading to an adjacent water vessel, but I left the other bulb naked." This was 19 years before Mason announced his hygrometer.

But there is another droll thing connected with this article, it contains the suggestion of having the bulbs of the thermometers of roughened or ground glass, which Mr. Marriott bethought him of as a novelty some 4 years ago.

Lampadius, 1817.—This consisted in a very delicate pair of scales, with the dried salts of a mineral spring in Thuringia in one glass pan, and brass weights in the other.

Mayer, 1818?—This writer says that he was very eager—*sehr begierig*—to make a hygrometer out of the thin skin on the inside of an egg shell. This is seriously reported in Gilbert's *Annalen*.

Kummer, 1818? proposed that the point of extreme dryness in goose quill hygrometers should be determined by exposure to sulphuric acid.

Grotthus, 1818.—This was a suggestion, but not, as far as I am aware, very systematically carried out. Grotthus was the first investigator of what at the time was called "anthrazionic acid," which in its dried form becomes the *crystallised potassic sulphocyanide* of modern chemists. As it possessed remarkable deliquescent properties, he suggested that it might be used for hygrometric purposes.

Adie (1), 1819.—Internal membrane of the *Arundo Phragmites* used like the rat's bladders. Also by using a strip acting against a lever, and so obtaining indication on a graduated circle.

Livingston, 1819.—This was only Gould's sulphuric acid hygrometer of 1688 re-invented.

Daniell (2), 1819.—Prof. Daniell's hygrometer consists of a glass tube twice bent at a right angle, the two parallel portions being of unequal length but each ending in a hollow glass sphere. The longer leg contains a small thermometer, the bulb of which is in the centre of the black glass ball, which terminates that leg. The other and shorter leg terminates also in a glass ball, which, however, is covered with fine muslin. The tube and balls, before hermetical closure, are exhausted of air, and a small quantity of very pure ether is placed in them. By applying the warm hand to the muslin-covered ball, and gently tilting the whole instrument, all the ether may be driven into the black ball, which will become about one-third full. The mode of observation consists in dropping a little ether on to the muslin covering of the short bulb; the cold thus produced condenses the vapour of the internal ether, and promotes evaporation from that contained in the black ball, which thereby becomes cooler, and as soon as, by the continuance of this process, the exterior of the black glass ball is cooled to the temperature of the dew-

point, its bright surface will be dimmed; the internal thermometer is then to be read and again a few seconds afterwards, when the dimness disappears; it is assumed that the mean of these two temperature readings is identical with that of the black glass on which the dew is deposited.

The thermometer attached to the pedestal of the instrument is intended to give the air temperature at the time of observation.

Owing to the necessarily small size of the enclosed thermometer it is difficult to read accurately small fractions of a degree, and it is, perhaps, open to question whether the internal thermometer really is at the same temperature as the outer glass surface, on which the dew is deposited.

Daniell (3), 1820.—This was in many respects a considerably better instrument than the first pattern, but curiously enough specimens of it are excessively rare; I have never seen one, and the instrument is almost unknown. The chief differences are (1) that the instrument is almost all made of thin metal instead of glass; and (2) that the thermometer is not a little one enclosed in one leg of the instrument, but is made with a thick stem and a small bulb. The tube is ground down and fixed air-tight through a brass cap, which fixes a portion of the tube and the bulb into the metal ball, on which the dew is to be deposited; the length of the thermometer is, therefore, unlimited, and delicate readings can easily be obtained.

Landrianus, 1820.—This was an attempt at recording the extreme variations of a Saussure's hair hygrometer during the observer's absence, and was also used with a strip of gold beater's skin. It consisted in adding to the instrument, as designed by Saussure, toothed wheels and ratchets, so as to retain indicators at the extreme points reached.

Anderson, 1820, (?) soaked paper in a weak solution of chloride of lime, then dried it and suspended it to one arm of a very sensitive balance.

Dobereiner, 1822.—This instrument contained the germ of both Connell's and Regnault's, anticipating each of them by many years. Ether was to be placed in a thimble-shaped tube of polished metal, into which vessel also passed the bulb of a thermometer, and two small tubes, one open to the air, the other connected with a syringe, so that by working it a current of air could be forced through the ether, and any requisite depression of temperature could be produced, so that dew would be formed upon the outside of the thimble even in the driest air.

Greiner, 1822, surrounded that part of the bulb of Daniell No. 2 on which dew is first deposited with thick gilding.

Koerner, 1822.—This was a thermometer with the lower part of the stem curved into a semicircle and ending in a hemispherical and slightly cup-shaped bulb, in the hollow of which a fragment of cotton wool was placed, and ether dropped upon it until dew was deposited on the surrounding portions of the thermometer-bulb.

Blackadder, 1822.—A terribly complex apparatus, but really resulting in a sort of recording dry and wet-bulb. I do not know that one was ever used.

Kastner, 1824.—Sulphuric acid in a balance once more—first used in 1688.

Schoen, 1824.—This is hardly worth mention, but some one may have heard of Schoen's hygrometer and may think this list imperfect if it be not mentioned. Schoen said that the seed vessels of a *Pelargonium* would make a good hygrometer, but he did not say how they were to be used.

Babinet, 1825.—This was an immense improvement upon Saussure's hair hygrometer, for all friction was abolished. A pierced tube of brass was mounted on a pedestal; to the upper part were separately attached three hairs, each loaded with a small weight at the bottom; these weights were of course raised and lowered according to the length of the hairs. Behind the weights there were divided scales, and in front there was a micrometer to read off the indications with extreme precision. The point for extreme dryness was ascertained by putting concentrated sulphuric acid in the base of the instrument and then closing it by adding an outer sheath; the extreme of humidity was obtained by the same arrangement, only using water instead of sulphuric acid.

De la Rive, 1825.—Van Mons in 1809 made experiments as to the rise of temperature produced by wetting a thermometer-bulb with sulphuric acid. De la Rive repeated the experiments, but seems to have abandoned them, chiefly because the results did not accord with the indications of a Saussure's hair hygrometer.

Jones, 1826.—This is an ordinary thermometer, supported on a brass pedestal by a hinge; it has a black glass bulb, surrounded by muslin, so as to allow of its being cooled by ether being poured upon it, and, evidently, when the evaporation of the ether has cooled the bulb to the temperature of the dew-point, the dullness deposited on the black glass will show it, and the thermometer scale will give the temperature. This is almost identical with Koerner's, but the bulb of Jones's thermometer was much larger than that of Koerner's.

Prinsep, 1827.—This was in general appearance very much the same as Chiminello's modification (in 1784) of Saussure's hygrometer, but it differed in principle, as Prinsep proposed to use two hairs, one cleansed from grease and one not so treated.

Cumming, 1828.—This is almost identical with Döbereiner's, the main difference being that a pair of bellows is substituted for a syringe, and that the current of air is sent direct through a saturated sponge on to the bulb of the thermometer.

Bohnenberger, 1828.—This was a very simple form of dew-point thermometer. It merely consisted of a thermometer, of which the bulb was covered with muslin, and of a short glass tube just large enough to freely admit the bulb. Ether was to be poured in above the bulb, and the temperature was to be read off when dew appeared. Even if a few drops passed the bulb no harm would result.

Adie (2), 1828 ?—Thermometer with delicate bulb inside an exterior ball of glass, part of outer bulb covered with muslin and wetted with ether, and part not. Dew observed on uncovered part and temperature then read off; interval between thermometer and outside bulb filled with mercury. To be shaken when observed.

Adie (3), 1829.—This was a thermometer with a rather large bulb of black glass; the upper half of the bulb was covered with muslin and to be wetted with ether, and the deposition of dew was to be noted on the lower half.

Hayes, 1829.—The cylindrical bulb of a thermometer projects below its scale, and goes into the middle of a brass cylinder whose diameter is about twice that of the thermometer-bulb. This cylinder is closed at the bottom, and at the top screws on air-tight to the scale of the thermometer; round the middle of the cylinder is muslin, and round the bottom a ring of platinum. To make an observation, nearly fill the tube with alcohol, and screw on to the thermometer, hold slantwise, wet the muslin with ether, and observe the temperature of dew arriving and departing.

Brunner, 1830, first introduced the Chemical hygrometer for the quantitative measurement of the amount of water contained in a given volume of atmosphere. He took a tube about 11 inches long and half an inch in diameter, filled it with dried asbestos, then added 50 or 60 drops of sulphuric acid, and having weighed the tube, drew through it, by means of an aspirator, half a cubic foot of air, and then re-weighed it.

Pouillet, 1832.—Prof. Pouillet, in his *Elémens de Physique* (T. IV. p. 733), describes the following arrangement, which, although he does not specifically claim it as his own, always goes by his name:—A very delicate thermometer is fixed bulb uppermost against a slab of ivory, the ivory itself being firmly fastened on a little pedestal, and forming the support of the parts hereafter to be described. Attached to the upper part of the ivory scale, and at such a height that its lowest part is level with the lowest part of the thermometer bulb, is a small, very thin, cylindrical cup, made of highly polished sheet gold. The cup is $1\frac{1}{2}$ inch in diameter, and not quite $\frac{1}{2}$ inch deep; in fact, its depth must be about a tenth of an inch greater than the diameter of the bulb of the thermometer, round the stem of which it is firmly fixed. In order to use the instrument sulphuric ether is poured into the cup, where it rapidly evaporates, the temperature falls, and the observer watches the indication of the thermometer, and also the brightness of the rim of the cup, and when the latter becomes dimmed by the deposit of dew the thermometer indicates the dew-point temperature.

Connell (1,) 1835.—A water-bottle-shaped vessel of thin brass about $1\frac{1}{2}$ inch in diameter, also a thermometer with cork collar cut to fit neck of bottle. Mix together equal parts of nitre and sal ammoniac, and keep well stoppered. Provide also two tubes, one to hold 40 grains of the mixed salts; the other, $\frac{1}{4}$ ounce of water; put in salts, then the water gently; then cork and agitate till dew appears.

Mason, 1836.—A long article by J. A. Mason, entitled "On a New Hygrometer," appeared in the *Records of General Science* for July, 1836, together with an engraving of the instrument. The writer ignores all previous use of it, but it was in all its essential features identical with the arrangement of dry and wet-bulb engraved by August in 1830, and nearly so with Boeckmann, 1802, and Gordon, 1817, while the principle may be traced back to Hutton in 1792, and slightly to Cullen, 1777. The only

thing which Mason did was to arrange a compact form of dry and wet for travelling purposes. He is alone in having covered both the bulbs with white Persian silk, one being further provided with floss silk leading into the water vessel.

Bache, 1840.—When it is required to determine the dew-point frequently at short intervals, the following apparatus, invented by Professor Bache, is very convenient. A small metallic box is filled with a mixture of salt and snow, by which means its temperature is reduced to about zero. From the side of the box projects a polished metallic bar, having on its upper side a groove, containing mercury, in which is immersed the bulb of a thermometer, which is suspended from a support, so that the thermometer is movable along the groove. One end of the bar has a very low temperature, while the other is but little below that of the surrounding air. That portion of the bar whose temperature is below the dew-point will be covered with moisture, while the other part will be dry, and the two portions will be separated by a well-defined bounding line. By placing the bulb of the thermometer opposite to this line, we may immediately determine the temperature of the dew-point. When only an occasional observation of the dew-point is desired, this instrument is inconvenient, because it requires considerable time to prepare it for experiment.

Savary, 1840 ?—Metallic thermometer in thin platinum box—with slit in side and a little gutter above in which ether is to be poured; the index of the thermometer is below, and has to be read off after dew is seen to be deposited on that part of the thermometer which is left open.

Regnault, 1845.—This consists of two very delicate thermometers, the bulbs of which pass through collars nearly to the bottom of two thin and highly polished silver cylinders. From near the bottom of these cylinders two tubes, which subsequently unite, pass to an aspirator. One of the silver cylinders has to be supplied with sufficient ether (Professor Everett says that alcohol will do) to completely immerse the bulb of the thermometer. The aspirator being filled with water and the tap at its base turned, air is drawn past the thermometer bulbs and through the two cylinders; in passing, however, through the one partly filled with ether, rapid evaporation is produced, the temperature falls, and when the cylinder is dimmed by the deposition of dew, that thermometer shows the dew-point temperature, and the other one that of the air.

A smaller and cheaper form is sometimes made, in which the air temperature is taken from an ordinary thermometer—one thermometer and cylinder being alone employed, and a suction pipe substituted for the aspirator.

Dollond, 1846.—This was merely an application of the variation in the length of a rod of mahogany cut across the grain, as the motive power of the hygrometrical part of Dollond's Atmospheric Recorder.

Haeghens, 1848, improved upon the chemical hygrometer, using a larger aspirator than Brunner, and employing U tubes for holding the absorbing medium, viz. pumice stone and concentrated sulphuric acid.

Ronalds, 1851.—This was a modified form of Regnault with one thermo-

meter and an aspirator, and a telescope for observing the deposition of dew upon the silver cylinder, it was put up at the Kew Observatory.

Andrews, 1851.—This was a proposal made with the object of rendering the chemical mode of determining the amount of vapour practicable to those not accustomed to chemical research. Dr. Andrews rejects both sulphuric acid and chloride of calcium, and proposes a U tube filled with dried calcined sulphate of lime or gypsum as an absorber; he attached a small gasometer to a Dutch clock in order to ensure the regularity of the aspiration. And the tube was, of course, to be weighed in the usual manner.

Connell (2), 1854.—This was invented by Prof. Connell, of St. Andrews. A delicate thermometer has its bulb encased in a spherical vessel of highly polished brass or of silver; this vessel has a short neck closed by a plug round the stem of the thermometer, and into this neck the nozzle of a small syringe is fixed. The silver bulb being partly filled with ether, on reducing the pressure by means of the syringe the ether evaporates, and so lowers the temperature both of the thermometer and of the covering bulb until dew is deposited upon it.

Vivian, 1856.—The patterns of hygrometer exhibited by Mr. Vivian at the Cheltenham Meeting of the British Association, and also in 1860, at the Oxford Meeting, have not to my knowledge been fully described or engraved. Their essential feature is, however, the quantitative measurement of the total amount of vapour of alcohol precipitated. They show, in short, by the length of the column of condensed spirit, what has been the mean difference between the dry and wet-bulb thermometers since the previous observation.

Woodbury, 1871.—This is generally known as the chemical hygrometer—called also most inaccurately the chameleon *barometer*. It consists of paper treated with a strong solution of chloride of cobalt, to which is added chloride of sodium and gum arabic. It is blue when dry but changes gradually towards pink with increasing humidity. In England these are usually made as discs surrounded by a scale of tints, in France they are made as bunches of flowers.

Dines (1), 1871.—This is essentially a dew-point instrument, and in many instances will give the point without the use of ether. In the original pattern the plate of glass on which the dew was to be deposited was horizontal, and the mode of making an observation was as follows:—

A little water and ice, or cold water only, is put into a cup, and allowed by a tap to flow gently through a small chamber whence it rises through a perforated diaphragm into the space under a slab. In this space, which is covered water-tight by a thin smooth piece of silver, or of black glass, rests the bulb of a sensitive thermometer; the water flowing gently from the spout cools the cover and the contained thermometer; when the temperature reaches the dew-point, a decided film of dew will be visible, the temperature being shown on the graduated stem of the thermometer. The tap enables the rate of flow of the water to be regulated with accuracy, and the temperature of the water under the glass slab to be thereby kept at any required point.

Sire, 1872.—M. Sire, of Besançon, exhibited at the meeting of the *Sociétés Savantes* at the Sorbonne, Paris, a form of hair hygrometer in which the tension was provided by a spiral watch-spring.

Whitehouse, 1872.—This was a modification of the arrangement brought out by Van Mons in 1809, and by De La Rive in 1825, for observing the rise of temperature of a thermometer wetted with sulphuric acid.

Baumhauer, 1874.—This was a combination of Brunner's chemical hygrometer with the principle of a hydrometer. A U tube is filled with pumice stone wetted with sulphuric acid, and, on air being drawn through it, the absorption of moisture by the acid causes an increase in the weight of the tube, which varies with the amount absorbed.

Negretti and Zambra, 1874.—An arrangement of the dry and wet-bulb whereby a perfectly accurate record of the temperature of both thermometers can be ensured at any required time, and in the absence of the observer. It is an application of the principle of Negretti's maximum thermometer to the dry and wet-bulb hygrometer.

Lowe, 1875.—This instrument is almost beyond my limit, as its only novelty consists in a very ingenious mechanical arrangement for obtaining, from the readings of the dry and wet-bulb thermometers, with which it is furnished, the corresponding dew-point, degree of humidity and grains of vapour in a cubic foot of air.

Buys Ballot, 1876, exhibited parts of a chemical balance hygrometer at the Loan Collection Exhibition at South Kensington, but I have no details of it.

Geissler, 1876 ?—This instrument consists of a pillar carrying two thermometers, one of the usual pattern, and the other of the following intricate form. Starting from the top we find firstly an ordinary thermometer tube and its scale, then the tube is bent round and a double cylindrical bulb is formed, in the interstice of which is the mercury which forms the bulb of the thermometer; the cylinders are welded into one about half-way up, and thus the thermometer bulb is closed, then the cylinder is contracted to a tube, and the tube ends in a hollow spherical bulb. Before closing this bulb, a little ether is poured through it and the tube into the cup of the inner cylinder of the thermometer bulb. Muslin is tied over the terminal bulb, and then the action is evidently as follows:—Drop ether on the muslin, its evaporation will cool that bulb, the ether in the thermometer-bulb-cylinder will evaporate and also cool, thus the temperature of the double cylindrical bulb will cool until dew is deposited on its surface, and then the temperature can be read off at once.

Klinkerfues, 1876 ?—This is a hair hygrometer, but differs from Saussure's and all others, inasmuch as it is the stiffness of the hair which actuates the instrument and not its variation in length. A wisp of half a dozen hairs, each about 2 inches long, is kept rigid at each end, and in the middle is slightly twisted by a spring; the drier the air the more does the rigidity of the hairs stretch the spring, and on the contrary, in damp weather the spring overcomes the power of the hairs: this variation is by simple mechanical means made to turn a hand upon a graduated dial. The indications of the

instrument are given in degrees of relative humidity, but reduction discs are supplied with the instrument, whence it is said that the dew-point can be ascertained.

Alluard, 1877.—The essential features of the instrument are a square brass tube, gilt and highly polished, to contain ether (the evaporation of which by the passage of a current of air causes cooling and condensation of the vapour in the atmosphere upon its exterior) and a thermometer. This tube has two small windows which allow the ebullition of the ether to be seen. The thermometer passes through the top of, and has its bulb in the middle of, the square tube, and is to be read at the instant at which dew is seen to be deposited upon the exterior of the tube. The air temperature is shown by an external thermometer.

A small tube on the right hand passes inside the square tube to near its bottom, and a tube on the left hand side only passes into the top. When an observation is to be made, ether is poured into the funnel until it rises halfway up the window in the square tube. By blowing into the small tube on the right hand side the air is forced through the ether in the square tube, cold is produced, and dew is deposited upon the bright surface of the tube. Precisely the same effect is of course produced by attaching an aspirator to the tube on the left hand side.

We now come to the two new features which distinguish this hygrometer from all others yet regularly sold, though each feature has, in some respects, been partly anticipated.

The first specific feature is the deposition of the dew upon a flat surface. M. Alluard is, we believe, the first to apply a flat surface to an ether-condensation hygrometer, though Mr. Dines has used it in his cold-water-hygrometer for years. There is no doubt as to the great advantage of the change, the deposition is more easily seen than on a round surface, and is indeed visible at a distance of 8 or 10 feet.

Secondly, the face of the square tube is surrounded by a similar surface, which is separated from it, and is not cooled. The comparison of these two surfaces renders it more easy to observe when the tube is dimmed, than it would otherwise be. I believe that a duplicate round tube was used for this purpose with a Regnault's hygrometer at Kew, but with that exception the method is, I think, new.

Those who have often used Daniell's or Regnault's hygrometers are aware that the readings of the thermometer when the dew is first seen and when it disappears rarely agree, and the mean is generally taken. The difference between these values may be regarded as the error of the instrument, and M. Alluard claims for his, that this difference is extremely small, rarely so much as 0°·4 F.

Schwackhöfer, 1878.—Prof. Schwackhöfer considers that the most satisfactory determination of the amount of aqueous vapour suspended in the atmosphere is that of directly estimating it by analysis by volume, which may be worked with a comparatively simple apparatus, kept ready to hand, and capable of giving the desired result with accuracy in a few minutes.

As to the degree of delicacy required, it may be remarked that as 0·1mm (0·039 in.) of vapour tension represents about 0·018 per cent. of the volume of aqueous vapour in the air, the apparatus should indicate with certainty the change of one-hundredth per cent. or one-ten-thousandth part in the volume of air measured.

Schwackhöfer considers that his instrument may be employed in place of ordinary psychrometers for daily observations at meteorological stations, since it is always ready for immediate use, and without much calculation will give the humidity, the operation occupying about ten minutes or a quarter of an hour.

The principle of the instrument may be briefly stated to be as follows:—a volume of air is enclosed in a glass vessel and its temperature accurately determined; it is then forced into a second vessel, where by intimate contact with concentrated sulphuric acid, it is deprived of all its water. The dried air is then again transferred to the first vessel, and the amount which it has lost in volume is measured. If the temperature and pressure be the same as before drying, a short calculation, based on the quantity determined, gives the vapour tension at the time of the experiment.

In the case of fog, the air is heated slightly before it is passed into the apparatus, so that the watery vesicles may be converted into vapour.

Schwackhöfer shows by a small calculation that the acid is not materially deteriorated as regards its drying properties by many thousands of operations.

As, however, the receiver and its divided tube form virtually an air thermometer, it becomes of vital importance to maintain the temperature of the air as nearly as possible constant during the operation, and to determine it with the greatest possible accuracy at least to 0°·05 F. With the view of maintaining this constancy of temperature, the receiver is surrounded with a large jacket apparatus, filled with glycerine.

Bogen, 1879.—This is a neat form of condensation hygrometer, in which no ether is used. Imagine the capital letter T reversed, and bulbs placed at the end of all three strokes—that is, one high one in the centre, and two low ones, one on each side; the centre and one of the sides are to be connected on one glass tube. The middle bulb is to be open like a vase, and into it is to be put a few grains of nitrate of ammonia; into the low bulb which is in connection with this vase is to be put some water; both the lower bulbs are to be platinised and highly polished; each is to contain a thermometer. An india-rubber ball and elastic tube enable the observer to force the water from the lower bulb to the vase, where it dissolves some of the salt, and becomes sufficiently cool to cause, upon its return into the lower bulb, a deposition of dew on the platinised bulb.

Dines (2), 1879.—Mr. Dines, having found that there was occasional difficulty in working his instrument, either from the absence of water sufficiently cold or of ice or snow, designed a smaller and more compact instrument, which can be used either with cold water or with ether. With water, the mode of use is identical with that of the original form. When ether is to be used, it is to be poured in at the spout, and will then pass into the front

f the chamber in contact with the thermometer bulb and behind the thin plate. A breathing tube, like that supplied with the simpler form of ult's hygrometer, has, at the end of it furthest from the mouthpiece, a copper pipe which has been ground to fit tightly into the spout. On eing placed in position, and the tube breathed through, evaporation of her is produced and dew is deposited on the glass slab.

CHRONOLOGICAL INDEX OF INVENTORS OF HYGROMETERS.

nne	1644	Baptista	1785	Livingston	1819
	? 1660	Bjerkander	1785	Daniell	1820
	1664	Chiminello	1785	Landrianus	1820
	1665	De la Guerrand	1785	Anderson	? 1820
s	1670	Cazalet	1786	Blackadder	1822
	1670	De Luc	1786	Döbereiner	1822
	1670	De Luc	1788	Greiner	1822
	1670	Richeus	1789	Koerner	1822
)	? 1670	Mann	1790	Kastner	1824
er	1672	Volta	1790	Schoen	1824
	1681	Coventry	? 1790	Babinet	1825
	1683	Coventry	? 1790	De la Rive	1825
	1683	Polius	? 1790	Jones	1826
eux	1685	Rabellio	? 1790	Prinsep	1827
;é	1688	Hutton	1792	Cumming	1828
ıa	1696	Barbosa	1797	Bohnenberger	1828
henbroek	1731	Hocheimer	1797	Adie	? 1828
ırd	1737	Leslie	1799	Adie	1829
ımel	1737	Lüdicke	1799	Hayes	1829
ırd	? 1744	Lüdicke	1799	Brunner	1830
uliers	1744	Seiferheldius	1800	Pouillet	1832
ing	1744	Monnier	? 1800	Connell	1835
)n	1745	Forster	1801	Mason	1836
)n	1745	Boeckmann	1802	Bache	? 1840
)n	1746	Dalton	1802	Savary	? 1840
i	1751	Lüdicke	1802	Regnault	1845
son	1764	Perricot	1802	Dollond	1846
ert	1768	I. R. I	1804	Haeghens	1848
)n	1771	Berzelius	1808	Andrews	1851
c	1773	Conversinius	1808	Ronalds	1851
ırt	1774	Guyton de Morveau	1808	Connell	1854
)dzoff	1776	Gough	1809	Vivian	1856
	1777	Kater	1809	Woodbury	1871
	1777	Soldner	1809	Dines	1871
)ier	1777	Van Mons	1809	Sire	1872
dins	1778	Daniell	1812	Whitehouse	1872
;au	1780	Leslie	1813	Baumhauer	1874
re	1780	Burrhard	1816	Negretti & Zambra	1874
c	1781	Wilson	1816	Lowe	1875
n	1782	Gordon	1817	Buys Ballot	1876
ıello	1783	Lampadius	1817	Geissler	? 1876
	1783	Grotthus	1818	Klinkerfues	? 1876
)er	1783	Kummer	? 1818	Alluard	1877
ıello	1784	Mayer	? 1818	Schwackhöfer	1878
	1784	Adie	1819	Bogen	1879
ta	1785	Daniell	1819	Dines	1879

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or.	Date.	Authority.
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LTS OF EXPERIMENTS MADE AT THE KEW OBSERVATORY WITH BOGEN'S AND GEORGE'S BAROMETERS. By G. M. WHIPPLE, B.Sc., F.R.A.S., F.M.S., Superintendent of the Kew Observatory.

[Read April 20th, 1881.]

ill be remembered by the Fellows, that they have had at various s brought before their notice different plans for filling barometers in a manner that the operation may be performed by travellers, or other ons not provided with the appliances ordinarily used for conducting this ation, or endowed with the considerable amount of professional skill ssary to perform the delicate manipulation required for the boiling of a satisfactorily.

ie first method to which I would allude is the one devised by Captain ge, R.N., and described by him in the *Quarterly Journal*, Vol. II. p. 29,

Capt. George was not ambitious of doing more than assisting a traveller to make his own barometer, and his very ingenious method of wiping out the air bubbles entangled in the mercurial column by means of a bunch of feathers tied to a twisted catgut cord is remarkably simple, and at the same time, as experience proves, is very effective.

Since Capt. George wrote his paper, he has introduced many improvements in the details of his instruments, and they are now coming into general use by travellers.

The second method is that designed by Mr. F. Bogen, and described first by Mr. Marriott in the *Quarterly Journal*, Vol. IV. p. 70, and afterwards more fully and with illustrations by Mr. Bogen himself, in Vol. V. p. 187.

The peculiarity of this instrument as regards the method of filling is, that the inventor considers that agitation of the tube in a particular manner (which he terms "pumping") is sufficient to extract the air so thoroughly, that "by its means a perfect *vacuum* can be obtained, such as could hitherto only be produced by an air-pump." In fact, Mr. Bogen's faith in his process is so great, as to lead him to recommend barometers constructed after his plan, as superior instruments for standards to those filled by boiling the mercury in the ordinary manner.

The details of construction of Mr. Bogen's instruments are also very ingenious, and present some points worthy of attention on the part of instrument makers.

On Mr. Bogen's departure for South America, shortly after he communicated his paper to the Society in 1879, he placed two of his instruments in my hands for experiment—having previously paid three visits to the Kew Observatory, and given both myself and my assistants full instructions as to the method of performing the necessary manipulations connected with the barometers. Having now completed a lengthy series of experiments and comparisons, I beg leave to place a brief notice of the results obtained before the Fellows of the Society.

At the time of reading the original paper, it was, I believe, suggested that the shaking the tube, or the so-called "pumping" of Mr. Bogen, did not actually liberate the air-bubbles entangled in the mercury, but only subdivided them still more minutely. The inventor, however, expressed as his opinion that the air was completely removed, and that the bubble which after the operation made its appearance at the top of the tube was oxygen occluded by the mercury. The results of our experiments, however, do not favour this hypothesis.

Our experience has been that in every case although the greatest possible care may have been taken with the filling, and although, immediately after the conclusion of the operation, the top of the column appeared to be quite devoid of air, yet an hour afterwards a small speck of, perhaps, 0·02 in. in diameter would be seen there. If the tube were then left in an erect position, not placed horizontally as the inventor prefers to keep it, a gradual increase in the size of the air-speck would be observed from day to day, until, perhaps a week after filling, it had attained a maximum diameter which in some cases exceeded 0·1 in.

It is not my intention to offer any opinion as to the value of the peculiar disc method of reading the barometer, devised by the inventor; we have throughout the comparisons read the level of the mercury in both upper and lower limbs of the barometers by means of a standard cathetometer, so that we have avoided any uncertainty that might be attendant upon newer methods of observing.

Mr. Bogen left two instruments in our care, marked respectively A and C; unfortunately, when the experiments were but half completed, the original tube of barometer A was broken, and it was necessary to replace it by a new one, which was not graduated.

In all, the tubes have been filled and emptied about twenty times, and more than fifty sets of comparison made between Bogen's and the Kew Standard Barometer.

In every case it has been found that the mercury in the Bogen tubes stood lower than it did in the ordinary Standard. The means of all the observations made after filling the tubes under ordinary circumstances and at atmospheric temperature, show that the column in Barometer A stands on the average 0·18 in. too low, and in Barometer C 0·21 in. too low; the differences ranging in the case of the first instrument from 0·06 in. to 0·28 in., and in the second from 0·08 in. to 0·26 in.

As it seemed highly probable that moisture played a most important part in bringing out these observed depressions, experiments were made in filling the tubes with mercury heated up to 90° and with the tubes as hot as they could be conveniently handled, the whole operation being performed in front of a good fire. The results proved to be much superior to those obtained by the ordinary method, and the errors were considerably reduced; the mean being for Barometer A only 0·006 in., with extremes of 0·008 in. and 0·010 in., and for Barometer C 0·008 in. with variations of ±0·001 in. As a final proof that the improvement was due to the absence of water vapour, Barometer C was filled one day in the open air when the relative humidity was 90; the result showed the depression of the Bogen to be 0·42 in., *i.e.* it stood nearly half an inch below the ordinary barometer at a pressure of 29·8 in.

With a view of comparing the relative efficiency of the new method of filling tubes with the "spiral cord method" of Capt. George, I searched the testing books of the Observatory, and found that since 1878 we have made about eight sets of observations on instruments filled by that plan, with the result that the mean depression given by the feather and cord experiment is 0·05 in., and the extremes 0·08 in. and 0·08 in. As these values are so much less than the values obtained by the "pumping" process, I decided to try the former plan on Mr. Bogen's tubes; but not having one of the peculiar twisted catgut cords at hand, I was compelled to extemporise a substitute out of a piece of iron wire, to the end of which I attached the bunch of well-baked feathers. Fortunately it turned out that the new method answered on the whole perhaps better than Capt. George's, and we found on completion of the experiments that with tube A we obtained a number of readings

all within 0·01 in. of the true height, and with tube C we got a mean depression of 0·02 in. with a variation of ±·01 in.

Finally, heating both the mercury and tube A up to 90°, we refilled and feather-swept it, but found on observing it the next day that it still read about 0·01 in. lower than the Standard.

It may, I think, be safely concluded from the account of the above experiments that the spiral cord is to be more relied upon for giving better Torricellian *vacua* under ordinary circumstances than the "pumping" method of filling barometer tubes, but that when both mercury and tubes can be pretty strongly heated, the pumping produces the better exhaustion. The George method also has a great advantage of showing the maximum depression at once; under the other system it is found that the depression may go on increasing for even a week, as the air gradually creeps up to the top of the tube.

The relative value of the two systems is perhaps best shown by the experiment made in the open air on Saturday, March 5th, when it was very damp. The two tubes A and C were filled side by side, A by the feather sweeping, and C by the pumping process. Both tubes were carried indoors and set up in their places after the operation, and left till Monday. When read, A stood 0·027 in. too low, and C 0·420 in.—the depression in the latter case being 15 times as large as that in the former. The following table gives the details of the various experiments above described.

TABLE of Errors of Mr. Bogen's Barometers, as determined by comparison with the Standard Barometers of the Kew Observatory.

Tube A filled by				Tube C filled by			
Bogen's Method.		George's Method.		Bogen's Method.		George's Method.	
Mercury at Temp. of Room.	Mercury and Tube warmed to 90°.	Mercury at Temp. of Room.	Mercury and Tube warmed to 90.°	Mercury at Temp. of Room.	Mercury and Tube warmed to 90°.	Mercury at Temp. of Room.	Mercury and Tube warmed to 90.°
In.	In.	In.	In.	In.	In.	In.	In.
—0·17	—0·01	—0·01	—0·01	—0·08	—0·01	—0·03	—0·02
—0·17	—0·01	—0·01	—0·01	—0·08	—0·01	—0·03	..
—0·18	—0·01	—0·01	—0·01	—0·26	—0·01	—0·03	..
—0·11	—0·01	—0·01	—0·01	—0·25	..	—0·01	..
—0·11	—0·01	..	..	—0·25	..	—0·01	..
—0·11	—0·01	..	..	—0·26	..	—0·02	..
—0·06	0·00	..	..	—0·26	..	—0·02	..
—0·20	—0·01	..	..	..	..	—0·02	..
—0·20	0·00	..	..	..	..	—0·02	..
—0·23	0·00	..	..	..	..	..	..
—0·23	..	..	..	..	..	..	..
—0·23	..	..	..	..	..	..	..
—0·23	..	..	..	..	..	..	..
—0·23	..	..	..	..	..	..	..
Means —0·18	—0·01	—0·01	—0·01	—0·21	—0·01	—0·02	—0·02

My best thanks are to due to Mr. T. W. Baker, F.M.S., my first assistant,

and also to Mr. T. Gunter, for the great assistance they have afforded me in the prosecution of these experiments, and also to the Kew Committee for their kind permission to publish the results of our work.

NOTE ON A DISCUSSION OF MR. EATON'S TABLE OF BAROMETRIC HEIGHT AT LONDON, WITH REGARD TO PERIODICITY.

By G. M. WHIPPLE, B.Sc., F.R.A.S., F.M.S., Superintendent of the Kew Observatory.

[Read April 20th, 1881.]

THE following brief notice affords merely negative results, but although such is the case it may possibly be deemed advisable to place them on record.

With a view to inquire whether Mr. Eaton's long series of barometrical values at London, published in the *Quarterly Journal*, Vol. VI. p. 191, would exhibit any term of periodicity in the annual means, I submitted them to the same method of reduction that I used when determining the non-periodicity of rainfall, and described in the *Proceedings of the Royal Society*, Vol. XXX. p. 70. Accordingly, I have computed the means for each year in terms of years varying in length from 5 to 18, together with the variation of these means from the mean of the whole period discussed—100 years.

The results are given in Table I. (p. 190.)

From this table the years of maximum and minimum pressure were determined for each series; for example, in the five year series, those years represented by $(1775+5n)$ would be maximum years, and those by $(1776+5n)$ years of minimum.

Next the average variation of each year's reading from the mean of the century was found to be ·084 in., and accordingly values of 29·952 ins. ±·084 in. were taken as limiting values. All years found to exceed these limits were then marked;—those above 29·986 ins. as years of maximum, and those below 29·918 ins. as minimum years.

An enumeration being made of the numbers of these maxima and minima falling in the years marked as above as the extremes in each series, the ratios were determined of the proportion between the number of cases where the observed maxima or minima coincided with the computed maxima and minima or failed to do so; these results are given in Table II. (p. 191.)

In all cases it was found that the non-coincidences far exceeded the coincidences in number, so proving conclusively that at London no periodicity of an integral number of years in duration between 5 and 18 exists in the average annual height of the barometer.

NOTE ADDED APRIL 25th.

Mr. Archibald having suggested that probably better results indicating a barometric periodicity would have been obtained by me, had I omitted from my discussion those observations which were not comprised between the assigned limiting values, I have accordingly gone over afresh the tables for 10, 11, and 12 year cycles.

TABLE I.—Barometric Periodicity at London.

Year of Series.		1	2	3	4	5	6	7	8	9	10	11	12	13	Mean.
5 years ..	Means ..	Ins. 29·955	Ins. 29·965	Ins. 29·928	Ins. 29·957	Ins. 29·954	..	..	..	..	..	..	..	..	Ins. 29·952
	Diff. ..	+·003	+·013	—·024	+·005	+·002	..	..	..	..	..	..	..	..	..
6 years ..	Means ..	29·957	29·942	29·931	29·954	29·967	29·962	..	..	..	..	..	..	..	29·952
	Diff. ..	+·005	—·010	—·021	+·002	+·015	+·010	..	..	..	..	..	..	..	..
7 years ..	Means ..	29·946	29·929	29·956	29·966	29·942	29·963	29·962	..	..	..	..	..	..	29·952
	Diff. ..	—·006	—·023	+·004	+·014	—·010	+·011	+·010	..	..	..	..	..	..	..
8 years ..	Means ..	29·959	29·947	29·931	29·949	29·976	29·967	29·939	29·947	..	..	..	..	..	29·952
	Diff. ..	+·007	—·005	—·021	—·003	+·024	+·015	—·013	—·005	..	..	..	..	..	..
9 years ..	Means ..	29·941	29·956	29·945	29·964	29·942	29·961	29·961	29·966	29·930	..	..	..	..	29·952
	Diff. ..	—·011	+·004	—·007	+·012	—·010	+·009	+·009	+·014	—·022	..	..	..	..	..
10 years ..	Means ..	29·972	29·971	29·922	29·962	29·954	29·939	29·958	29·935	29·950	29·954	..	..	..	29·952
	Diff. ..	+·020	+·019	—·030	+·010	+·002	—·013	+·006	—·017	—·002	+·002	..	..	..	..
11 years ..	Means ..	29·962	29·941	29·950	29·955	29·925	29·969	29·966	29·967	29·962	29·940	29·932	..	..	29·952
	Diff. ..	+·010	—·011	—·002	+·003	—·027	+·017	+·014	+·015	+·010	—·012	—·020	..	..	..
12 years ..	Means ..	29·983	29·947	29·912	29·962	29·966	29·977	29·934	29·936	29·953	29·946	29·967	29·944	..	29·952
	Diff. ..	+·031	—·005	—·040	+·010	+·014	+·025	—·018	—·016	+·001	—·006	+·015	—·008	..	..
13 years ..	Means ..	29·946	29·942	29·940	29·965	29·939	29·967	29·962	29·927	29·964	29·961	29·948	29·960	29·956	29·952
	Diff. ..	—·006	—·010	—·012	+·013	—·013	+·015	+·010	—·025	+·012	+·009	—·004	+·008	+·004	..

TABLE II.

Period.	Coincidences.	Non-Coincidences.	Ratio of Non-Coincidences to Coincidences.
Years.			
5	15	24	1·6
6	11	22	2·0
7	19	37	1·9
8	17	33	1·9
9	16	38	2·4
10	20	41	2·0
11	14	32	2·3
12	17	18	1·1
13	12	34	2·8

Having struck out the 44 years, when the mean stood either above 29·986 ins. or below 29·918 ins., the remaining 56 years were discussed, giving the following results (Table III.) :—

TABLE III.

10 year period.

.....	1774. +10n	1775. +10n	1776. +10n	1777. +10n	1778. +10n	1779. +10n	1780. +10n	1781. +10n	1782. +10n	1783. +10n
.....	Ins. 29·958	Ins. 29·955	Ins. 29·943	Ins. 29·961	Ins. 29·957	Ins. 29·956	Ins. 29·957	Ins. 29·946	Ins. 29·947	Ins. 29·956
from Mean	+·003	0·000	—·012	+·006	+·002	+·001	+·002	—·009	—·008	+·001

11 year period.

.....	1774. +11n	1775. +11n	1776. +11n	1777. +11n	1778. +11n	1779. +11n	1780. +11n	1781. +11n	1782. +11n	1783. +11n	1784. +11n
.....	Ins. 29·957	Ins. 29·963	Ins. 29·957	Ins. 29·939	Ins. 29·939	Ins. 29·945	Ins. 29·957	Ins. 29·956	Ins. 29·965	Ins. 29·973	Ins. 29·951
from Mean	+·002	+·008	+·002	—·016	—·016	—·010	+·002	+·001	+·010	+·018	—·004

12 year period.

.....	1774. +12n	1775. +12n	1776. +12n	1777. +12n	1778. +12n	1779. +12n	1780. +12n	1781. +12n	1782. +12n	1783. +12n	1784. +12n	1785. +12n
.....	Ins. 29·950	Ins. 29·951	Ins. 29·936	Ins. 29·965	Ins. 29·955	Ins. 29·954	Ins. 29·963	Ins. 29·951	Ins. 29·949	Ins. 29·958	Ins. 29·959	Ins. 29·944
from Mean	—·005	—·004	—·019	+·010	·000	—·001	+·008	—·004	—·006	+·003	+·004	—·011

Selecting from these the years of maximum and minimum and contrasting them with the series, the coincidences and non-coincidences of epoch are as follows:—

	Coincidences.	Non-coincidences.	Ratio.
10 year series	10	18	1·8
11 „ „	9	15	1·7
12 „ „	10	17	1·7

These values fail, even more than those given in the paper above, to indicate any trace of a periodicity, the relations between the non-coincidences and coincidences of computed with observed maxima and minima being more unequal than they were in the previous instance. Hence the undisturbed values of barometric pressure do not appear to be affected by any marked fluctuation equal in period to either of the three values assigned above.

DISCUSSION.

Mr. ARCHIBALD said that he objected altogether to Mr. Whipple's method, as affording an accurate criterion of the existence of a period in the figures given by Mr. Eaton. Of the whole number of years Mr. Whipple only took those which deviated above or below the mean deviation of 0·034 in. The remaining years he entirely omitted. Now he (Mr. Archibald) thought that in attempting to discover traces of periodical maxima and minima, account should be taken not merely of the isolated peaks and hollows which lay beyond the limits of the mean deviation, but of all deviations from the mean; since the former were probably due to what we must at present term accidental causes, superadded to the more regular and less marked fluctuations of secular period. The values lying within the mean deviation of 0·034 in., which Mr. Whipple excluded, were, he thought, the very ones most likely to exhibit signs of secular periodicity. Periodical maxima and minima were generally characterised by two or three years in succession, giving an average above or below the mean of the whole period. He thought if Mr. Whipple included *all* the years of observation, he might possibly arrive at very different results. While it was quite possible that no very marked period of an integral number of years existed in the mean annual barometric pressure of London, he had, by applying Prof. Balfour Stewart's criterion of the existence of an inequality of long period, given in *Nature*, Vol. XXI., No. 545, to all the groups of figures given by Mr. Whipple, found some traces of a 12 yearly period. He (Mr. Archibald) had, moreover, by taking Mr. Eaton's figures for the barometric pressure of London from 1810 to 1879, and comparing them by Mr. Meldrum's method with the sunspots, obtained distinctly positive results.

Mr. WHIPPLE thought that Mr. Archibald could not quite have understood his method of reduction, for he actually had made use of all the years of the Eaton series when determining the periods of maximum and minimum; not merely those which had overlapped either one way or the other the limiting value, as Mr. Archibald had inferred. He could not understand what was to be accepted as a year of maximum barometric pressure, if it were not to be a year when the absolute mean exceeded the ordinary limits of deviation from the mean height of a long series, or a year of minimum unless it were one when it fell below the lower limiting value. Although he did not wish to deny, as Mr. Archibald seemed to infer he did, that a small underlying periodical variation might possibly exist, whether due to solar influence or not he would not stop to inquire, yet he believed that his investigation proved conclusively that it is impossible at present to predict, taking as the basis of prediction the observations of the past century, what would be even the approximate mean height of the barometer at London in any stated future year. Such was the object aimed at in his paper, and he ventured to think he had attained it.

PROCEEDINGS AT THE MEETINGS OF THE SOCIETY.

MARCH 16th, 1881.

Ordinary Meeting.

GEORGE JAMES SYMONS, F.R.S., President, in the Chair.

Rev. ANDREW JAMES CAMPBELL ALLEN, Peter House, Cambridge;
EDWARD CHAPMAN, M.A., Frewen House, Oxford;

Rev. EDWARD WHITMORE FORD, 19 Castle Street, Carlisle;
GEORGE THORN GWILLIAM, F.R.A.S., 35 Lansdowne Crescent, Notting Hill, W.;
HERBERT BASIL JUPP, M.A., Clifton College, Bristol;
ALEXANDER RAMSAY, F.G.S., 6 Kent Gardens, Ealing; and
JOHN STOKES, Aspen House, St. Peter's Road, Margate,
were balloted for and duly elected Fellows of the Society.

The Paper read was:—

"A CONTRIBUTION TO THE HISTORY OF HYGROMETERS." By G. J. SYMONS, F.R.S., President. (p. 161.)

After the reading of this Paper, the Fellows adjourned to another room, where the following instruments had been arranged for exhibition, viz.:—

ANNUAL EXHIBITION OF INSTRUMENTS.

MARCH 16th, 1881.

1. **Leslie's Hygrometer.** *Exhibited by* P. ADIE.
2. **Dines's Hygrometer,** original pattern, for use with iced water. *Exhibited by* L. P. CASELLA, F.M.S.
3. **Regnault's Hygrometer,** with double bulb. Do.
4. **Scale and Instructions of Hygrometer,** by Prof. G. M. C. Barnabita. Do.
5. **Daniell's Hygrometer,** unusual shape. *Exhibited by* G. DINES, F.M.S.
6. **Dines's Hygrometer,** first attempt. Do.
7. " " first made. Do.
8. " " to test glass against metal for deposit of the dew. Do.
9. " " for use with water or ether, metallic face, the centre separated from the outer part of the metal. Do.
10. **Meteorological Journal,** from 1824-27, with observations of the dry and wet bulb thermometers. Do.
11. **Damp Detector.** *Exhibited by* J. J. HICKS, F.M.S.
12. **Dry and Wet Bulb Thermometers** (Marriott's arrangement). Do.
13. **Bogen's Hygrometer.** *Exhibited by* W. MARRIOTT, F.M.S.
14. **Weather House Hygrometer.** Do.
15. **Improved form of Rain Gauge receiving bottle.** *Exhibited by* E. MAWLEY, F.M.S.
16. **Jones's Hygrometer.** *Exhibited by* NEGRETTI & ZAMBRA.
17. **Leslie's Hygrometer.** Do.
18. **Turn-over Dry and Wet Bulb Thermometers.** Do.
19. **Mason's Hygrometer** with Table for calculating Dew Point. *Exhibited by* F. PASTORELLI, F.M.S.
20. **Dry and Wet Bulb Thermometers** with glass scales. Do.
21. " " " with glass scales for travellers. Do.
22. " " " mounted on brass pedestal. Do.
23. **Sick Room and Hospital Meteorological Case.** *Exhibited by* Dr. B. W. RICHARDSON, F.R.S.
24. **Alluard's Hygrometer.** *Exhibited by* THE METEOROLOGICAL OFFICE.
25. **Klinkerfues' Patent Hair Hygrometer.** Do.
26. **Lowe's Graphic Hygrometer.** Do.

27. **Regnault's Hygrometer.** *Exhibited by* THE METEOROLOGICAL OFFICE.
28. **Saussure's Hair Hygrometer.** Do.
29. **Damp Detector.** *Exhibited by* G. J. SYMONS, F.R.S., F.M.S.
30. **Catgut Hygrometer.** Do.
31. **Daniell's Hygrometer.** Do.
32. **De Luc's Whalebone Hygrometer.** Do.
33. **Dines's Hygrometer,** new pattern, for use with water or ether. Do.
34. **Mason's Hygrometer.** Do.
35. **Photographs of Yorkshire Waterfalls, January 1881.** Do.
36. **Saussure's Hair Hygrometer.** Do.
37. **Radiogram obtained by Winstanley's Radiograph.** *Exhibited by* THE KEW OBSERVATORY.
38. **Slide Rule for Hygrometric Calculations,** by J. Welsh. Do.
39. **Table to facilitate finding the Humidity of the Air,** by H. C. Russell. Do.
40. **Whipple's Cloud Camera.** *Exhibited by* G. M. WHIPPLE, F.M.S.
41. **Admiral Jerningham's Hygrometer.** *Exhibited by* R. H. C. WILSON.
42. **Moisture Meter.** Do.
43. **Swan Quill Hygrometer.** Do.

APRIL 20th, 1881.

Ordinary Meeting.

CHARLES GREAVES, M.Inst.C.E., F.G.S., Vice-President, in the Chair.

WILLIAM HENRY GOSS, F.G.S., Stoke-on-Trent; and
ADMIRAL THOMAS LEACHE MASSIE, Stanley Place, Chester,
were balloted for and duly elected Fellows of the Society.

The following Papers were read:—

FREQUENCY AND DURATION OF RAIN. By Dr. WLADIMIR KÖPPEN of Hamburg.

(Translated from the 'Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie,' 1880. Band XV., p. 362, by J. S. HARDING, F.M.S.)

THE treatment of atmospherical precipitation, which is such an important element in the climatological characteristics of a district, presents special difficulties, owing to its irregularity and the intermittence of its occurrence. The simple totals of the monthly and yearly amount of rainfall, which are generally given, are far from sufficient for the determination of the climate, since, according to this method, a single rain-storm will occasionally be given as equivalent to a number of steady, persistent rains, while perhaps the former only interrupted a long period of drought for a part of an hour, and therefore, was a matter of little consideration, from a purely meteorological, as well as from an agricultural point of view—if we disregard any chance damage it may cause. Apart from the aggregate amount, the falls must also be characterized according to their intensity, their frequency, and their duration, in order to furnish an approximately complete representation. With regard to frequency, an enumeration of every individual period of rainfall or of fine weather, is, strictly speaking, impossible,—because in every steady rain there are times when no rain falls, although the amount of cloud and all the other meteorological factors have not in any way changed; and this, by itself, without any further distinctions, would decidedly not be characteristic, as, according to this method, such a

moment of freedom from rain would receive the same value as a dry interval of many days' duration.

In order to afford a comparable determination of the frequency of rain, the most suitable method would therefore be the enumeration of the intervals, of not too short duration, in which rain has or has not fallen ; and the civil day is certainly the only natural interval which can here be taken into consideration. It is therefore very satisfactory that the enumeration of days with rainfall is becoming more and more adopted since it was recommended by the Meteorological Congress. This method furnishes satisfactory results and at the same time offers great simplicity, and even after a few years' observations clearly shows the principal features of the rainfall, especially of the yearly period. But if used by itself this method also leaves us completely in ignorance of many essential features of the rainfall ; even if by this method an individual down-pour cannot be treated as equivalent to a number of moderate rains, on the other hand it places a day with a light shower, for say a quarter of an hour, on a par with one with rain lasting day and night, and therefore its mean values give us absolutely no information as to the prevalent nature of the rainfall of a district. In order to learn the latter we must generally have recourse to the personal impressions recorded in accounts of travels, &c. ; to its accurate determination, however, belongs the knowledge of the mean duration and intensity of rainfall. Instead of the latter data, which denote the amount of rainfall in the interval, the average rainfall of a rainy day is often given, and the term " density of rain " is used. M. Wojeikoff has rightly observed that the day is too large a unit for this determination, and these figures—which nevertheless are far from useless—represent a compound result of the intensity and duration of the rainfall. For although, for instance, the summer rains in South Russia occur much more frequently in the form of rain-storms than in the Baltic Provinces, the average rainfall of a wet day on the lower Volga, &c., is less than on the Baltic, as the Southern showers, although frequently violent, are, owing to their extremely short duration, less copious than the drizzling rains of the North. M. Wojeikoff has shown this in the case of Orenburg, where the observations as to the time of the occurrence of the rainfall, are made with great exactness, and number of hours with rain, and, from them, the mean duration for a rainy day as well as the mean amount of rainfall per hour of rain, are calculated and compared with similar values for Brussels.

All this makes the knowledge of the absolute duration of rain or the mean duration of rain on a wet day very desirable. The very praiseworthy endeavours which have been made in Brussels and Belgium to determine this value, by accurate observations for a number of years, have, however, remained very isolated owing to the great demands which such particulars, if they are to be accurate, make upon the observer. In damp climates especially, the constant attention of the observer is necessary to record the above-named continually occurring pauses of the rainfall upon wet days ; and for carrying on the observations during the whole of the 24 hours of the day, arrangements are necessary for night service, which are only available at very few observatories indeed, and can only be partially fulfilled by self-registering apparatus. Matters are certainly much more favourable on board ship, where, for the safety of the vessel, the weather must be observed by the officers of the watch during the whole voyage, both day and night, and all that is wanting is the necessary love of the subject to record the observations carefully in the log in spite of weariness.

An approximate determination of the desired value—the average duration of rain in hours, may meanwhile be arrived at in a very simple way. The usual calculation of mean values for all meteorological elements from 1 to 24 (most frequently 3) epochs during the day rests directly upon the supposition that, in these periods selected at pleasure, we possess sufficient representatives for the whole of the time, and that the mean derived from these epochs, after any necessary correction for the daily range, accords with the true mean. And in this, so far as relates to a perfectly casual selection of individual elements, we are quite justified, if the number of cases is sufficiently great for the desired degree of accuracy of the result. The same supposition as in the case of other phenomena, that on an *average* the conditions—after elimination of the possible daily range—are the same at the instants of observation as, in the whole interval, can also be extended with the same right to rainfall, so that if it rained r times

in n observations and was dry t times (at the epoch of observation), we may assume that also in the whole of the other time, or interval, $\frac{r}{n}$ was accompanied with rain and $\frac{t}{n}$ was dry

Therefore if N denotes the total number of hours in a month, in which from many years' observations rain was indicated in $\frac{r}{n}$ of all instants of observation, then $R = \frac{r}{n} N$ will be the probable total duration of rain in this month expressed in hours. It is much to be regretted that the arrangement of most registers, especially in the case of those published, is such that the easy and certain determination of the fact (which is also in other respects very desirable) whether it has rained or not at the time of observation, is impossible; we should otherwise have sufficient material for deciding, in the main features, the question of the duration of rain which is so important for Climatology, as well as the character of the rain for a large number of places (especially if the number of days of rain is known as well). Under present circumstances, in pursuing the subject we must keep to the Daily Weather Reports, in which as a rule (but unfortunately not without exception) the weather at the moment of observation, and especially the fact whether it rained, snowed, hailed, or was dry, is unequivocally given. We choose the Weather Reports of the *Deutsche Seewarte* for the years 1877 and 1878 and limit ourselves—as it is only a question of a trial of the method—to a small number of German stations. For such a short period, the mean of the monthly total duration of the rain makes no pretence to be a reliable representation of the normal values; the quotients of the duration by the number of rainy days of the same month, *i.e.* the mean duration of the rain on a rainy day gives much better information, as here the numerator and denominator of the fraction are to a certain degree equally influenced by the anomaly of the year under consideration. I lay stress, therefore, in the following table, on these characteristic values, and combine two or three stations into geographical groups:—

Number of Observations and Days with Rain, and Mean Duration of Rain in hours on a rainy day.

1877 and 1878.		Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.
Baltic (Swinemünde and Neufahrwasser)	Observations ..	38	30	43	38	27	19	22	34	22	24	31	42
	Days	80	61	77	56	62	47	74	74	61	55	53	68
	Mean Duration	3·8	3·9	4·5	5·4	3·5	3·2	2·4	3·7	2·9	3·5	4·7	4·9
Holstein (Hamburg and Kiel).....	Observations ..	52	45	51	18	25	16	29	31	28	33	37	48
	Days	84	79	90	53	74	54	87	96	64	70	76	86
	Mean Duration	4·9	4·6	4·5	2·7	2·7	2·4	2·7	2·6	3·5	3·8	3·9	4·5
North Sea (Keitum and Borkum)....	Observations ..	50	42	66	26	23	20	22	38	30	53	65	60
	Days	66	68	90	44	66	49	72	83	70	73	86	89
	Mean Duration	6·0	4·9	5·9	4·7	2·8	3·3	2·6	3·7	3·4	5·8	6·0	5·4
Central Germany (Crefeld, Cassel, Breslau reduced to 2 stations)	2/3 Obsns.	47	45	52	25	23	11	21	23	20	29	31	42
	2/3 Days.....	79	75	89	51	73	45	76	67	54	66	65	64
	Mean Duration	5·4	5·3	5·3	4·4	2·8	2·2	2·6	3·4	3·3	4·3	4·8	6·5
South Germany (Friederichshafen and Carlsruhe) ..	3/2 Obsns.	55½	52½	103½	55½	57	21	31½	40½	30	28½	49½	61
	Days	59	58	87	72	76	46	72	68	45	58	54	75
	Mean Duration	7·5	7·2	9·5	6·2	6·0	3·7	3·5	4·8	5·3	3·9	7·3	6·5
Brussels	Mean Duration from direct Observation	6·5	5·1	5·5	4·4	3·6	3·8	3·1	3·2	4·0	4·1	5·7	5·9

The numbers in the lines "observations" and "days" denote respectively the sums of the actual observations and the days on which rain, snow, &c., were observed for the two years, and all stations of the group together. Three observations were used, viz., 8 a.m., 2 p.m. and 8, 9 or 10 p.m., except for Carlsruhe and Friederichshafen where the 2 p.m. observation was wanting in the reports. For the sake of comparison, the numbers in the first line for this group are multiplied by $\frac{4}{3}$; for the same reason, in the group "Central Germany" which does not embrace two but three stations, the numbers are multiplied by $\frac{3}{2}$. Thus the numbers of all the groups are directly comparable, and those of the column "observations" are all to be divided by $12m$ and those of the following line by $4m$, in order to deduce the probability of any observation of rain and that of any day with rain, as given by this series of 2 years' observations; m denotes the mean number of days in a month (28·4, 30 or 31).

Notwithstanding the short period of observation, and the few observations each day, the numbers given in the lines "mean duration" exhibit a very good agreement and a regular range. In all groups the mean duration on a rainy day amounts in July to only about the half of what it is on such a day in December or January; and this is also the case from 28 years of direct observations on the duration of rainfall at Brussels, as shown by the last line of the table, the numbers of which generally, as well as in their absolute quantity, show a better agreement with the majority of the German stations than could be expected.* How far, with regard to the yearly period, the existing deviations in the individual groups would disappear if more data were used cannot yet be stated. Generally, however, the period from May to September, with shorter rainfalls, is contrasted with a portion of the year which is more abundant in really lasting rainy days. Exceptions only are shown in South Germany owing to a rainy May and dry October, and in Holstein owing to the shortness of the April rainfalls. In the cool period of the year the individual groups exhibit great differences. It appears strange that the mean duration of the rain in the interior of Germany is absolutely not less than on the coast.

The method of determining the total time from a number of individual observations is the same as that employed in every technical and other test, where the character and value of a larger quantity is calculated from a number of samples taken at pleasure. This method is only permissible when the individual determinations are completely uninfluenced; in our case and others it is only permissible, when the weather of a previously determined epoch of time is noted (not chosen according to circumstances), and not, as often occurs, when a rain which took place half-an-hour earlier or later is entered as if it had taken place at the time of observation. Casual errors have little influence on the final result; methodical errors which are always made in the same direction decidedly affect the result, even when they are apparently quite inconsiderable in individual cases. But if the observations are correctly made, the method indicated undoubtedly gives results of great value for climatology, the more valuable since the simplicity of the required observations—if only mistakes are excluded—greatly limits the sources of error.

The values obtained for the proportion of the observations with rainfall to the total number of observations during the period under consideration, in so far as we disregard the ordinary daily period of rainfall, is only dependent on the number of observations made each day to this extent, that they are the more exact, the greater their number; their independence of the choice of any unit whatever of time, measure, &c., induces me to propose their notation by the expression "absolute probability of rain" instead of the probability of a day with rain which, since Kämtz' time, has been roughly taken as the "probability of rain."

If we have ventured to point out in the above, that the want of decision in the determination of the state of the weather at the epoch of observation, with respect to hydrometeors deprives climatology of a valuable material, we think we must add that this want is still more injurious in the case of synoptic meteorological researches. The researches made at the *Seewarte* with the Daily Weather Charts have shown indications of a regularity in the simultaneous superficial

* The figures for Brussels have been calculated from Quetelet's data and printed in the 'Zeitschrift' for 1870, p. 13.

distribution of hydrometeors and of their relation to pressure (*vide* Index to the monthly summaries under "Rain-bands"), the further prosecution of which is very desirable. But for this purpose it is necessary to be able to determine accurately, by means of a very large number of stations spread over a very large space, with several observations each day, where it rains and where it does not. The endeavour of the Signal Service, in its great publication the "*International Bulletin of Simultaneous Observations*," is in fact directed towards this end. It is often thwarted, however,—especially in Europe—by the desire of the observers to give more, which induces them to give in the column for "*Weather*," not their observation at the moment of making it, but the entry of phenomena which have occurred during the preceding 24 hours. The want of a column for entries of the latter kind in the "*Bulletin*" is certainly to be regretted, and the mixing up of both kinds of indications is, however, under all circumstances to be avoided.

We shall now summarise the practical results to which our considerations have led us:—

1. It is necessary in the interest of climatology, as well as of synoptical meteorology, that precaution should be taken by suitable alterations in the forms for observation and in the instructions for observers, as well as in the form of publication, for the unequivocal record of the hydrometeors existing at the moment of observation (especially ●, ✳, ▲, △). In publication this can be effected, by making the columns for the record of cloud observations wider, so as to include the above signs, together with the exponents 0 and 2, if at the time of observation one of the specified hydrometeors existed; in the event of want of space the most important would suffice if several of the above forms occurred at one time—which, however, is not frequently the case. The observer's remarks, the detailed publication of which is very desirable, can be given with advantage, according to Kupffer's method, and as is now done in the *Jahrbuch* of the Austrian Central Office, at the side of the tables, when they are not cramped for room. With regard to the term "the epoch of observation," each observation occupies a certain time. When all the principal meteorological elements are included the observer can only be directed to make a fixed rule for the rotation in which these elements are to be observed, and to refer the estimation of the amount of cloud, together with the statement whether it rains, snows, &c., to a definite specified interval of time. The expression "Rain in showers," which is very suitable for the remarks because very characteristic, and which is denoted by "*p*" in the Beaufort scale, as well as the likewise indefinite expression "rainy," are therefore, of course, to be entirely avoided in the notation of the weather at the epoch of observation. These remarks refer, so far as regards the original day-books and instructions, to observers at sea as well as those at land stations; what arrangement of the forms is most suitable for the purpose must certainly be left to the decision of persons conversant with the matter and to further experience.

2. It is desirable to introduce as a new element into meteorological summaries for land and sea, an expression for the "duration of rain" or for the "absolute probability of rain," in one of the three forms:—

$$\frac{r}{n}, \quad \frac{r}{n} N., \quad \text{or} \quad \frac{r}{n} \frac{N}{d},$$

in which n is the total number of times of observation,
r. the number of times of observation with rain,
N. the total number of hours in the period under consideration (Month),
d. the number of days on which rainfall is noted (days with ●, ✳, ▲, △).

Therefore $\frac{r}{n}$ = the "absolute probability of rain,"

$\frac{r}{n} N$ = the probable total continuance of rain in the period under consideration,

$\frac{r}{n} \frac{N}{d}$ = the average duration of the rain upon a rainy day.

Dr. TRIPE considered that the present mode of registering rainfall was not satisfactory to the agriculturist, the medical man, or the meteorologist; for the total rainfall at one place could not satisfactorily be compared with that at

another. For instance, the natives of Penzance say that it rains there every day; but the total rainfall does not equal that of the Lake district, where certainly rain does not fall so frequently as in Cornwall or Scilly. But it was a serious consideration whether we should alter our present method not only as regards rainfall but also humidity, and a matter of this kind ought only to be considered in committee. He thought that our present forms and method of publication are open to further improvement.

Mr. BALDWIN LATHAM could not agree with the author of the Paper that registering rain-gauges only partially fulfilled the conditions necessary in observing rainfall. He could say with reference to his own registering rain-gauge, that it had been at work for over two years, and that it registered with accuracy the amount, the time, and therefore the intensity of the rate at which rain fell at various periods. In his opinion, observations made by self-recording apparatus were preferable to the notes made by observers. He agreed with the author that it was desirable to record, in addition to the rain falling, the intensity and frequency of the falls, for there was a great difference between an inch of rain falling in say one hour and a similar quantity falling in the course of a number of days, the amount of water contributed to the springs or rivers very largely depending upon the intensity of the fall. A moderate fall spread over some time might contribute little or nothing to either springs or rivers even at those periods of the year when the earth was sensitive to discharge the water falling upon it, but the same quantity falling in a limited period would either contribute a large proportion to the springs or rivers, or would pass to a considerable depth into the ground. With reference to judging of the frequency of rainfalls by noting the falls occurring at particular times of observation, he was of opinion that no reliance could be placed upon such results, for during the past two years there had been recorded by his own registering rain-gauge at Croydon 167 times when rain fell at a rate equal to or exceeding 1·44 in. per day, and of these heavy falls, only 29 occurred at or near the ordinary periods of observation, that is, near 9 a.m. and 9 p.m. The two greatest falls which had occurred in the period, viz. on July 10th, 1880, when ·13 in. fell in five minutes, and on December 29th, 1880, when ·23 in. fell in ten minutes, took place between 7 and 8 p.m., so that, judging from his observations, he could not conceive that any reliance could be placed upon calculations which were based upon rain falling at the fixed hours of observation.

Mr. SCOTT said that the time scale of the self-recording gauges in this country was rather too contracted to allow of picking out individual showers in the way Dr. Köppen suggested. As regards the calculation of the probability of rain, it was very desirable that some uniformity in methods of counting should be introduced. The amount taken as a "rainy day" was not always uniform, for Mr. Symons takes 0·010 in. as the limit to constitute that entry, the Meteorological Society takes 0·006 in., and the Meteorological Office, until recently, 0·001 in., in accordance with the Vienna Resolutions, which direct that any day on which any amount falls is to be entered as a rainy day.

Mr. LATHAM said that the time scale of the self-recording rain gauge could easily be extended by simply driving the drum more rapidly.

Mr. STRACHAN said all that was asked for in the Paper had been asked for over and over again, the difficulty was to get it. Eye observations could not be expected upon the duration of rain. Data of this kind, involving time, must be obtained from self-recording instruments. Observers at sea might attempt to keep account of rain duration, and indeed they were prompted to do so in the instructions for keeping the Meteorological Office Log. He would remind them that some fifteen years ago he read a Paper before the Society on the duration of rain.*

Mr. WHIPPLE thought that the proposed alteration in the method of recording rainfall was mainly a question of expense, and he considered that the funds of the Society would get very low if everything was printed that was suggested. He therefore did not think the Society could adopt the new method in its publications. The time scale of self-recording rain gauges could easily be extended if the Meteorological Council would undertake the expense of altering the instruments, and of providing the increased supply of paper.

* Proceedings, Vol. III., p. 254.

Mr. J. S. HARDING said—with reference to the remarks made by some Fellows about the preference to be given to self-recording rain gauges—that he thought that if places, generally, were supplied with such instruments the present Paper would perhaps not have been written,—although many such gauges do not denote the exact *time* of the rainfall. What the author asked for was for observations at a given moment of time at *ordinary* stations, and he gave a simple formula by means of which, and by observations taken say three times a day, or more frequently if possible, the rainfall may be treated like other meteorological elements, such, for instance, as temperature. The results arrived at in the table calculated by the author from observations taken from the German Weather Reports for each month in two years only, were borne out in a remarkable manner when compared with a 28 years' series of hourly observations made at Brussels. He thought that the method proposed by the author was worthy of the careful consideration of the Society.

Mr. ARCHIBALD said that though the examples given by the author of the application of his method to some places in Europe were probably of little value, owing to the small number of epochs of observation on which they were based, the method was well adapted to places where hourly observations could be taken. Certainly, in India, where at some seasons a heavy shower recurred daily between 3 and 4 p.m., deductions from tri-daily observations at 8 a.m. and 2 p.m. and 9 p.m. would yield utterly fallacious results.

Mr. GREAVES remarked that in all meteorological researches a more and more minute register of the periods of duration and accompanying phenomena of all kinds appeared necessary, and rain was no exception. But he wished to maintain that rain was only the obvious precipitation of moisture, and not the whole quantity of moisture which it might be possible to condense from the atmosphere. It was on this account that he had appeared solicitous to have registered the quantitative aspect of the humidity instead of the ratio of humidity to the varying scale of saturation. He had some time since read a Paper at the Institution of Civil Engineers on "Rainfall and Percolation," in which at the time the monthly values only were given. In working out all those tables in daily detail, evidence was afforded which went far to support the idea that a condensation of moisture, other than rain, took place and was registered by the sand percolation gauge. It was not yet perfectly clear whether this was additional or deferred precipitation. In many cases in summer, and in the driest weather, the proceeds from the gauge were continuous, daily, uniform and quite appreciable in amount, suggesting the arrest in the sand of a quantity of moisture resembling dew, but really a precipitation from damp air. In his opinion an exact knowledge of the weight of moisture present in the air at all times was the most desirable point of research, but he quite endorsed the views expressed by the author of the Paper relative to the more exact hourly measurement of rain and the periods of its fall.

"RESULTS OF EXPERIMENTS MADE AT THE KEW OBSERVATORY WITH BOGEN'S AND GEORGE'S BAROMETERS." By GEORGE MATHEWS WHIPPLE, B.Sc., F.R.A.S., F.M.S. (p. 185.)

"NOTE ON A DISCUSSION OF MR. EATON'S TABLE OF THE BAROMETRIC HEIGHT AT LONDON WITH REGARD TO PERIODICITY." By GEORGE MATHEWS WHIPPLE, B.Sc., F.R.A.S., F.M.S. (p. 189.)

RECENT PUBLICATIONS.

ANNALES DE L'OBSERVATOIRE ROYAL DE BRUXELLES, PUBLIÉES AUX FRAIS DE L'ETAT. Deuxième série. Annales Météorologiques. Tome I. 408 pp. 4to. 1881.

This contains:—I. Daily observations made at Brussels in 1876; II. Observations made at Climatological stations in Belgium in 1878; III. Ditto in 1879; IV. A paper by M. A. Lancaster on the observations of storms in Belgium during 1878.

ANNUAIRE DE LA SOCIÉTÉ MÉTÉOROLOGIQUE DE FRANCE. 28me Année, 1880. 4me Trimèstre. 4to. 1881.

Contains :—Résumé des observations centralisées par le service hydrométrique du bassin de la Seine, pendant l'anneé 1879, par M. G. Lemoine (83 pp.).—Note sur la fréquence relative du courant polaire et du courant équatorial, à Lorient, par M.A. Louvet (3 pp.).—Note sur la trombe du 23 Octobre, 1880, à Bertignolles, par M. C. Saillard (6 pp.).

ANNUAL REPORT OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION, showing the Operations, Expenditures, and Condition of the Institution for the year 1879. 8vo. 1880.

In the Appendix there is a paper giving a description of a Universal Meteorograph, designed for Detached Observatories, such as in Balloons, by E. H. Von Baumhauer (16 pp.).

ANNUAL REPORT OF THE ROYAL CORNWALL POLYTECHNIC SOCIETY. 8vo. 1881.

Contains a paper entitled "Notes on the Meteorology of Falmouth for the year 1880, by W. L. Fox, F.M.S., with Tables from West Cornwall and the Scilly Islands" (16 pp. and a folding diagram).

AUS DEM ARCHIV DER DEUTSCHEN SEEWARTE. II. Jahrgang: 1879. Herausgegeben von der Direktion der Seewarte. 4to. 1879.

This contains four papers, viz. I. Studien über den Wind und seine Beziehungen zum Luftdruck, Part 1. Zur Mechanik der Luftbewegungen. Von Dr. A. Sprung (33 pp.). II. Ditto. Part 2. Empirische Untersuchungen über die Beziehung zwischen Windstärke und Gradient und deren tägliche Periode, mit besonderer Berücksichtigung des deutschen Küstengebietes (24 pp.). III. Zweiter Jahresbericht über die Thätigkeit der Deutschen Seewarte für das Jahr 1879, erstattet von der Direktion (87 pp.). IV. Ueber die Veränderungen des Magnetismus in eisernen Schiffen nach Deviations-Beobachtungen auf deutschen Kauffahrtei-schiffen. Von Kapt. C. Koldewey (90 pp.).

BRITISH RAINFALL, 1880. On the Distribution of Rain over the British Isles, during the year 1880, as observed at more than 2,000 stations in Great Britain and Ireland, with Articles upon various branches of Rainfall work, compiled by G. J. SYMONS, F.R.S. 260 pp. 8vo. 1881.

In addition to the usual particulars on the Rainfall and Meteorology of 1880, General Tables of Total Rainfall, Monthly Rainfall at 230 stations, and other information, this book contains the following Articles :—Difference of Rainfall with elevation, by G. Dines.—On the amount of Rain collected at very considerable heights above the ground.—The rate at which Rain falls, by Baldwin Latham.—A few simple directions for the measurement of Snow under various conditions, by E. Mawley.

CIEL ET TERRE. REVUE POPULAIRE D'ASTRONOMIE ET DE MÉTÉOROLOGIE. May to July, 1881. 8vo.

The chief meteorological articles are :—Les Courants supérieurs de l'Atmosphère et leur influence sur la distribution des pressions barométriques, par Cte C. d'Espiennes (6 pp.).—Influence des particularités locales sur le chute de la grêle, par J. Vincent (4 pp.).

DIE WIRBELSTÜRME ODER CYCLONEN MIT ORKANGEWALT NACH DEM JETZIGEN STANDPUNKT UNSERER KENNTNISS DERSELBEN, in Form eines Handbuches gemeinfasslich dargestellt von A. SCHÜCK. 124 pp. with 11 plates. 8vo. 1881.

This work treats of Whirlwinds or Cyclones of hurricane force, according to the present state of our knowledge of them. Captain Schück having had long experience of typhoons in command of ships in the China Seas has, since his

return to Europe, visited the principal Meteorological Institutes of Northern Europe, and has, in this way, extracted a large amount of information from logs of ships, of which he makes good use in his present work.

ETUDES HYDRONOMIQUES. INFLUENCE DES FORÊTS SUR LES NAPPES LIQUIDES SOUTERRAINES ET SUR LA PLUIE. Hypothèses par CHARLES RITTER. 22 pp. 8vo. 1880.

The author treats the subject under the following heads: 1. Considérations préliminaires sur l'origine, les déplacements et le rôle Météorologique des nappes liquides souterraines. 2. De l'influence des forêts sur la pluie et les sources. 3. Aperçu de certaines applications des propositions précédentes.

HIMÁLAYAN DISTRICTS OF THE NORTH-WESTERN PROVINCES, by E. E. Atkinson. 4to. 1881.

Chapter V. is devoted to an Article (58 pp.) on Meteorology, by S. A. Hill, who treats of the following subjects: Preliminary sketch of climate. Contrast between the Eastern and Western parts of the Plain and the Himálaya. Radiation, solar and nocturnal. Temperature: diurnal and annual ranges, vertical decrement, height of snow line. Pressure and Winds:—barometric tides, mountain winds, annual variation of pressure, monsoons. Humidity: vertical distribution of vapour, relative humidity, cloud. Rainfall: distribution on plains, and on the Himálayan slope, annual variation, the winter rains, and the monsoon rains.

JAHRESBERICHT DES VEREINS FÜR ERDKUNDE ZU LEIPZIG. 8vo. 1881.

Contains a paper by Dr. A. von Danckelman, entitled "Die Ergebnisse der meteorologischen Beobachtungen des Herrn Hermann Soyaux in Ssibange-Farm am Awandu (Munda), Gabun, Westafrika, während des Jahres 1880." (14 pp.).

JOURNAL AND PROCEEDINGS OF THE ROYAL SOCIETY OF NEW SOUTH WALES. 1880. Vol. XIV. 8vo.

Contains two papers by H. C. Russell, viz. 1. Note upon a sliding-scale for correcting Barometer readings to 32° and mean sea level. 2 Thunder and Hail storms in New South Wales. The author cannot trace any period in their occurrence, except that they seem to be more numerous during the first year after a drought; but he draws attention to the great number of storms in the early part of November, or when the earth is passing through the November meteor stream.

RESULTS OF METEOROLOGICAL OBSERVATIONS MADE IN NEW SOUTH WALES during 1879, under the Direction of H. C. RUSSELL, B.A., F.R.A.S., Government Astronomer. 170 pp. 8vo. 1880.

This contains the results of regular observations at 84 stations, and of rainfall at 160 stations in New South Wales. A description of the Metograph in use at the Sydney Observatory, together with a photograph of the instrument, is given at the end of the volume.

RESULTS OF RAIN AND RIVER OBSERVATIONS MADE IN NEW SOUTH WALES DURING 1880: H. C. RUSSELL, B.A., F.R.A.S., Government Astronomer. 14 pp. 8vo. 1881.

This contains Tables giving the mean monthly amounts of Rain, together with the totals for the year, and the average fall at 191 stations; also the average heights of the Rivers at various places, and the date and height of the greatest flood. To these are added a Map, showing the distribution of rain, and a diagram showing the state of the Rivers throughout the year.

KONGELIGE SVENSKA VET. AKAD. HANDLINGAR. Band 6. No. 5. 8vo. 1881.

Contains a paper in French, by Dr. H. E. Hamberg, on the Diurnal variation of the force of the Wind (47 pp. and 2 plates).

PROCEEDINGS OF THE LITERARY AND PHILOSOPHICAL SOCIETY OF LIVERPOOL, during the Sixty-Eighth Session, 1878-79. No. XXXIII. 8vo. 1879.

Contains a paper entitled "On Modern Meteorology, considered in its bearings upon tropical storms," by A. E. Nevins (15 pp.).

REPORT OF THE INTERNATIONAL METEOROLOGICAL COMMITTEE. Meeting at Berne, 1880. Published by Authority of the Meteorological Council. Non-Official, No. 14. 62 pp. 8vo. 1881.

In addition to the report of the proceedings of the Committee, the Appendix contains letters or papers on the following subjects: Dr. W. Köppen on the registration of Hydrometeors.—Capt. Hoffmeyer on the importance of telegraphic communication with the Islands in the Atlantic.—Dr. Hellmann on the preparation of a Catalogue of Meteorological Literature.—Circular as to the carrying out of the Resolutions of the Congress of Rome, with replies.—Report on the Meteorological Organisation of England in 1876.

RESULTS OF THE MAGNETICAL AND METEOROLOGICAL OBSERVATIONS MADE AT THE ROYAL OBSERVATORY, GREENWICH, IN THE YEAR 1879: UNDER THE DIRECTION OF SIR GEORGE BIDDELL AIRY, K.C.B., Astronomer Royal. 165 pp. 4to. 1881.

In addition to a full description of the instruments, the methods of registration, and the results of the observations, this also contains Tables showing the monthly mean reading of the barometer, dry bulb, wet bulb, and dew point temperatures, and the relative humidity at every hour of the day as deduced from the photographic records.

TRANSACTIONS OF THE PLYMOUTH INSTITUTION AND DEVON AND CORNWALL NATURAL HISTORY SOCIETY. 8vo. 1881.

Contains a paper on The Meteorology and Climate of Plymouth, by Dr. J. Merrifield (23 pp.). This contains the results of observations extending over a period of sixteen years, 1865-80.

PROCEEDINGS OF THE ROYAL SOCIETY. Vol. XXXII. No. 213. 8vo. 1881.

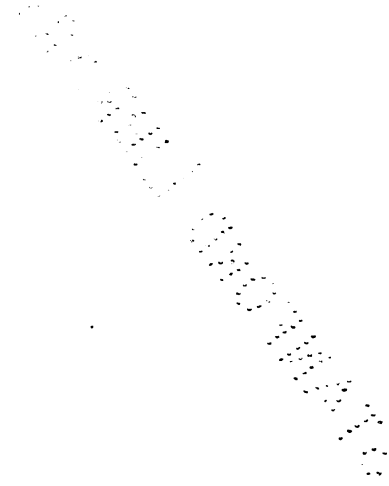
Contains:—Discussion of the Results of some Experiments with Whirled Anemometers, by Prof. G. G. Stokes, F.R.S (18 pp.). These experiments were made in the year 1872, by the staff of Kew Observatory, with three anemometers of different sizes, which were placed on a steam merry-go-round at the Crystal Palace. The following are the author's conclusions: viz. 1. That, at least for high winds, the method of obtaining the factor for an anemometer, which consists in whirling the instrument in the open air, is capable, with proper precautions, of yielding very good results. 2. That the factor varies materially with the pattern of the anemometer. Among those tried, the anemometers with the larger cups registered the most wind. 3. That with the large Kew pattern, which is the one adopted by the Meteorological Office, the register gives about 120 per cent. of the truth, requiring a factor of about 2·5, instead of 3. Even 2·5 is probably a little too high, as friction would be introduced by the centrifugal force beyond what occurs in the normal use of the instrument. 4. That the factor is probably higher for moderate than for high velocities; but whether this is solely due to friction, the experiments do not allow us to decide.

TRANSACTIONS OF THE HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB. Vol. 1. Part 8. 8vo. 1881.

Contains three papers by J. Hopkinson, viz. 1. Meteorological observations taken at Watford, during the year 1879. 2. Report on the Rainfall in Hertfordshire in 1879. 3. Report on Phenological observations in Hertfordshire in 1879.

ZEITSCHRIFT DER ÖSTERREICHISCHEN GESELLSCHAFT FÜR METEOROLOGIE. Redigirt von DR. J. HANN. XVI. Band. May to July, 1881. 8vo.

Contains:—Theorie des Psychrometers nach Maxwell und Stefan (6 pp.).—Ueber mehrjährige Perioden der Witterung, von Dr. W. Köppen (12 pp.).—Wie erhält man aus Regenbeobachtungen eine Begrenzung von Prognosenbezirken? Von Prof. A. Winkelmann (12 pp.).—Prof. Buys Ballot's methode der Berechnung des "Ueber-masses" von Luftdruck und Temperatur (5 pp.).—Beiträge zur Kenntniss der atmosphärischen Wirbel und ihre Beziehung zur cirruswolke, von Max Möller (8 pp.).—Die Aneroïdbarograph von Hottinger und Cie. (9 pp.).—Thermo und Hygrograph von Hottinger und Cie. (2 pp.).—Beitrag zur Sprung'schen Trägheitscurve, von Dr. J. Roth (4 pp.).—Schwankungen des Wasserspiegels der grossen amerikanischen Seen und des Ladoga-Sees, von Dr. A. Woeikoff (3 pp.).



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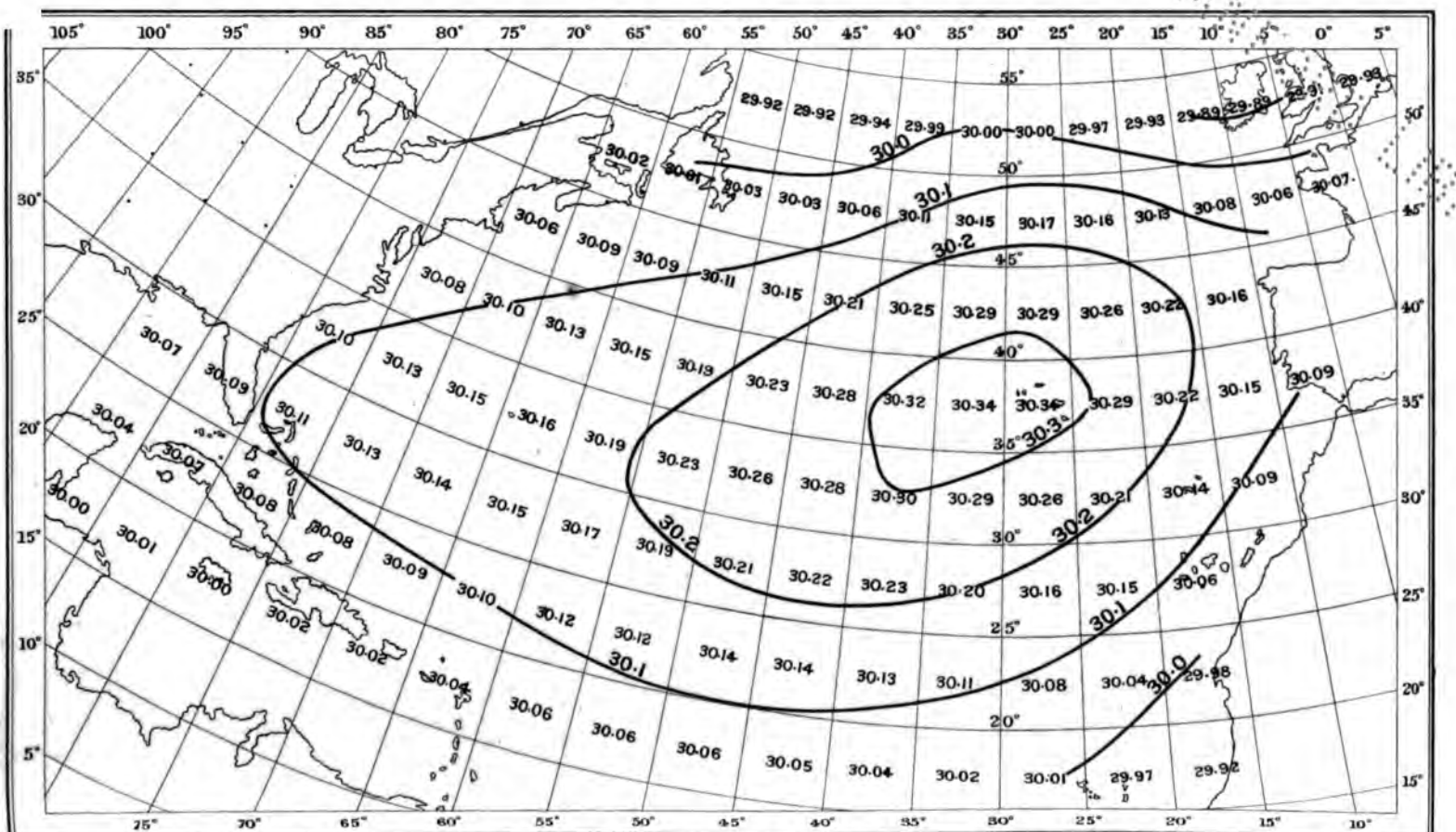

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COMPARISON OF ROBINSON'S AND OSLER'S ANEMOMETERS, WITH REMARKS ON ANEMOMETRY IN GENERAL.

By RICHARD H. CURTIS, F.M.S.

[Read May 18th, 1881.]

IN this note on anemometry I propose to offer some remarks on the present state of the subject, and to confine myself principally to the two chief forms of recording instrument used in this country, viz. those known as Osler's and Robinson's.

In the former of these the *pressure* of the wind, acting upon a surface freely exposed to it, is registered through the medium of springs upon a paper suitably placed for the purpose and moved by a clock. In the latter the *velocity* of the wind is obtained by means of four hemispherical cups placed at the extremities of two arms set at right angles to each other and free to revolve horizontally under the influence of the wind; the number of their revolutions being registered by a series of lines traced upon a paper, which is carried upon a cylinder moved, as in the former case, by clockwork.

The *direction* of the wind in either of these instruments may be obtained by using an ordinary arrow-vane or a windmill-vane; but neither of these forms of vane, as they at present exist, can be considered as quite free from objection.

The arrow-vane is without much doubt the more sensitive of the two in light winds, but it has the disadvantage of not always stopping at once at the right point when taking up a new position,—the distended arrangement at the rear of the vane for checking its momentum being commonly inefficient for the purpose when the wind is not very strong. When the record is obtained by a pencil attached to a rack, and moved by a pinion on the vane-shaft, this excess of motion not unfrequently takes the pencil off the paper, and, disengaging the pinion from the rack, causes the loss of several hours' trace

unless the accident happen to be noticed and set right. On the other hand, the windmill-vane while free from this fault is sluggish in light winds, and it is not an uncommon thing under such circumstances for the vane to record a direction very different from that which smoke and other light matters carried by the wind would indicate as being the true direction.

These defects, however, are not very serious, and such as they are might be easily overcome. A better form of break applied to the arrow-vane, such as fans working in a viscous fluid, might remedy its fault, and by making a smaller mass and weight necessary might even render it at the same time still more sensitive; whilst in any case the fact that these errors are only likely to occur with *light* winds greatly diminishes their importance.

The arrow-vane is usually employed in the Osler instrument, whilst the windmill-vane is generally applied to the Robinson cup instrument.

It is, however, less to the record of the wind's direction than to that of its force that I wish to direct attention, since it is there that the chief interest as well as the chief difficulties of anemometry lie.

I have already said that in Osler's pressure instrument the resistance overcome by the wind in moving a plate against the action of springs placed at its rear gives the measure of its force; the amount of the plate's movement being shown by a pencil mark on the paper. The special advantage of this form of instrument is that its trace is a record of the wind's force from moment to moment, from which by a simple inspection the maximum and minimum during a given period can be at once ascertained; whilst by enlarging the time scale nearly every movement of the pencil could be shown distinctly, and the absolute force at any instant ascertained.

There is a further distinct advantage gained in using pressure, rather than velocity, for expressing the force of the wind, since he former embodies the effect due to the *weight* as well as to the motion of the air; the latter giving the effect due to motion alone. The rate of rotation of the cups of a velocity instrument would be the same in a stream of water as in a stream of air, provided both moved at equal velocities, whilst the effect produced upon a pressure-plate under such circumstances would be very different in the two cases, since the component in the result, due to the different densities of the moving masses, would be registered by the plate though not by the cups. This factor is continually varying with the density of the air and its temperature; and, therefore, for most practical purposes, a knowledge of wind-pressure is more useful than that of wind-velocity, the former expressing the total destructive energy of a storm, while the latter evaluates merely a single component of the total energy, the co-efficient of which varies according to a law not yet fully understood.

Against these advantages, however, certain disadvantages have to be set. The essential parts of the instrument are the *plate* and the *spring*, and both are open to objection. The use of the spring is a constructional defect, because its strength and elasticity cannot be depended upon to remain constant under variations of temperature, exposure to weather, and continual use. In order to avoid this defect, the late Mr. Cator employed a system

of levers for the resisting medium; and in other cases other contrivances have been used, such as a wooden plunger in a cistern of mercury, &c., but I am not aware that any of these substitutes have been at all generally adopted.

The use of the pressure-plate, however, involves still greater difficulties, which directly affect the principle of the instrument. The impact of a stream of air upon the face of the plate produces a complicated system of currents which, whilst they materially affect the indications of the instrument, are not at all easy to understand. Such a stream reaching the centre of the plate is at once stopped, broken up, and deflected towards every side, flowing off in currents more or less inclined to the plane of the plate and approximately at right angles to the direction of the wind; they are interposed between the plate and other portions of the stream, which are also in their turn more or less deflected, and thus the question of what is exactly the ratio between the total force exerted upon the whole surface of the plate and that which would be exerted, were these modifying currents absent, becomes an exceedingly difficult one to solve. It is, however, probably less than the aggregate would be in the imaginary case of a stream striking the plate normally at all points of its surface at the same instant, and in which these deflected currents were not present. This defect of pressure has, however, to be considered in connection with another result of the currents, produced when they reach the edges of the plate. Here they form into eddies, and as such act upon the air at the back of the plate, drawing it away and so producing a partial vacuum there. Both sides of the plate are thus subjected to a defect of pressure, and as the *nett* result of the two disturbing elements the plate is probably moved *further* than it would be in the imaginary case just supposed,—the defect of pressure in front being more than counterbalanced by a still greater defect behind.

Mr. Osler, in his original paper describing his pressure anemometer, published in 1840, expressed his opinion that the pressure exerted by the wind on a plate was *less* than would be exerted on a wall, or other large surface, owing to the penning up of a large mass of air; but the great modification in the direct pressure which would be produced in such a case by the deflection of large currents trying to escape between the building and the main current of air, together with the probably still greater modification in the conditions at the rear of the building, where the effect of the eddies in reducing the pressure may be conceived to depend, at least to some extent, upon its dimensions and shape, appears to me to render this statement doubtful, and I should expect to find, under such circumstances, a materially *less* pressure, on a unit of area than the plate would record. I can hardly conceive otherwise how buildings,—houses, chimney-stacks, steeples, &c.,—could have weathered such pressures as have from time to time been recorded. To say nothing of the pressure at Liverpool on March 9th, 1871, when the limit of 40 lbs. was overpassed and the pressure was *estimated* to reach 90 lbs. per square foot;* at Greenwich, on December 8th of the following year, the

* Quarterly Journal of the Meteorological Society, Vol. II. p. 110.

pressure plate was driven past its limit of 30 lbs., and was estimated by the Astronomer-Royal to have reached at least 40 lbs. per square foot. That squalls of wind are not generally so limited in area as not to affect at once the whole of a moderate-sized wall or house, must be well known, and, therefore, it would seem that the reason why such buildings can endure blasts of such strength, can only be that conditions such as I have mentioned greatly modify the pressure really felt. From the same considerations also we can readily conceive that the shape and area of the plates in instruments of different types may, by modifying the effect of the currents, render their records discordant and a comparison of them difficult.

Before leaving the subject of pressure I may be allowed to mention Lind's wind gauge, which, although not a registering instrument, might yet be easily arranged to indicate maximum forces, and in that form could be usefully employed in conjunction with an Osler's instrument for determining the relation between the velocity caused by a head of air, of known pressure, and the effect such a current would produce on the pressure-plate, and thus supply data for a reliable table of wind velocities and equivalent pressures.

Pressure instruments are, however, in far less general use than the form of instrument known as Robinson's velocity anemometer.

The essential part of this instrument is the wind-wheel—four hemispherical cups placed at the extremities of two arms rigidly fixed at right angles to each other at the top of a vertical spindle; this wheel being free to revolve horizontally, its rate of rotation is governed by the velocity of the wind, and the number of its revolutions is registered graphically by the recording portion of the apparatus. The instruments vary considerably in size and pattern, but in the form adopted by the Meteorological Office, and which may probably be regarded as a standard, the cups have a diameter of 9 inches, and the arms are 24 inches long from the centre of the axle to the centre of the cups. For convenience of registration it is necessary to reduce the motion of the cups by a train of wheels, and in the type of instrument I have mentioned, 7,000 turns of the cups are required to make one complete revolution of the small cylinder on which is the recording pencil.

Obviously the first thing required in using this instrument is a knowledge of the relation between the rate of motion of the cups and that of the wind. In his paper describing the instrument, published in Vol. XXII. of the Transactions of the Royal Irish Academy, Dr. Robinson stated, as the result of experiments made to determine this relation, that the cups rotated with a velocity of one-third that of the wind, and that this relation was true for any type of instrument. The factor 3 has, therefore, always been used for all cup anemometers irrespective of the dimensions of cups and arms, or of the ratio of the one to the other.

More recently, in 1874, M. Dohrandt carried out a series of experiments at St. Petersburg with instruments of various types, from which he concluded that Dr. Robinson's factor was too great, that it should probably be only 2·5 instead of 3; and also that the factor varied with the type of instrument used.

In Vol. I. of the Quarterly Journal of this Society there is a paper by the

Rev. Fenwick W. Stow, giving the result of a series of comparisons made between an instrument of the standard pattern and several others of various lengths of arm and diameter of cup; this result, stated generally, was that the ratio of the movement of the cups to that of the wind depended on the length of arm and the diameter of the cups. He says, "The results of these experiments are, in the case of every instrument tried, utterly irreconcilable with Dr. Robinson's dictum that the centre of each cup travels at one-third of the rate at which the wind moves, and that this law is irrespective of the size of the cup or the length of the arm. Anemometers with short arms do not agree even approximately with the standard, excepting at low velocities. . . . . If the standard be assumed correct, the cups of most of the small instruments move through a space scarcely more than one-fourth of that passed over by the wind. . . . . It is evidently desirable, therefore, that a proper proportion should be observed between the size of the cups and the length of the arms."

In the Philosophical Transactions for 1878 Dr. Robinson has given the results of a second series of experiments made with a whirling machine in a building specially well adapted for the purpose, at Rathmines, near Dublin; these experiments were carried out with great care and attention to details, and from them the factor 2·286 was deduced instead of the original 3, the conclusion being also arrived at that the factor was practically identical for instruments of different types. This series was not, however, entirely satisfactory to Dr. Robinson, and it was, consequently, supplemented by another made in the open air with two instruments 22 feet apart and exposed to the action of the wind. An account of the method and results is published in the Philosophical Transactions for 1880. The factor obtained from this series was for the standard type of instrument, 2·831 *plus* a small constant due to friction; with smaller cups and arms (4 ins. and 10¾ ins. respectively), but having the same proportion to each other as in the standard, the factors rose to 4·961. Four-inch cups on arms 26·75 ins. long gave a factor of 3·436, and with 12 inch cups on 23·17 inch arms the factor again fell to 2·8202. Dr. Robinson concludes, therefore, substantially as Mr. Stow, that not only must anemometers be equal, as well as similar, to give similar results, but that the factors will also depend upon the diameter of the cups as well as the length of arm.

From this it will be seen that the important point of the ratio of the movement of the cups to that of the wind is as yet by no means well settled, and if Dr. Robinson's last factor for the standard instrument be correct, wind velocities hitherto obtained by that type need to be reduced about 6 per cent., whilst if the factor deduced from the Rathmines experiments be adopted, nearly 24 per cent. must be deducted; and further, it is evident that no direct comparison can be instituted between instruments of different types until the factor for each type has been obtained by direct experiment.

Another point to which attention ought to be drawn is the want of uniformity in the conditions under which different instruments are set to work, an important point to consider in comparing their results. I am not now

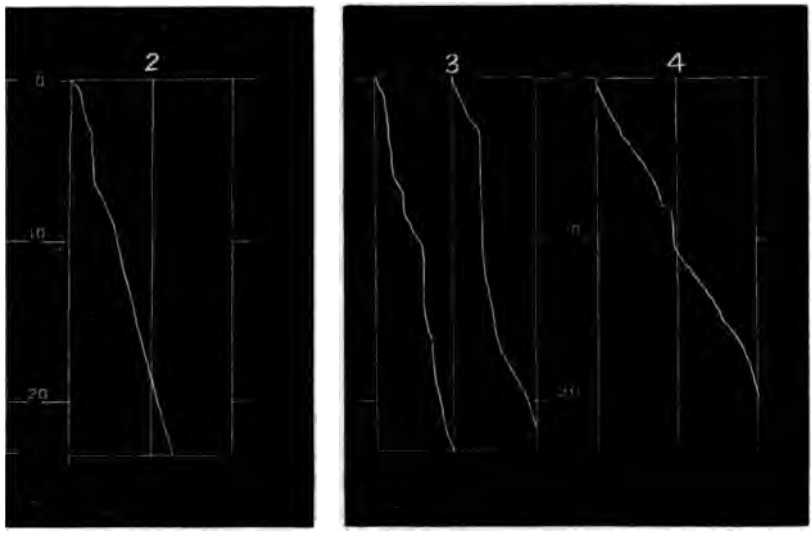
referring to *exposure*, but to the position of the recording apparatus with regard to the cups. I know of one instrument in which the cups are about 150 feet above the recording pencil, that length of vertical shafting intervening between the two; and of another where, in order to have the recording apparatus in a certain position, a number of shafts (six or seven, measuring in all about 140 feet) in different directions, with an unavoidably large amount of friction and loss, due to the gearings, has been employed. Probably it is not too much to say that no two instruments have yet been erected in which the conditions of friction, &c., are in any great degree similar; and, therefore, in order to render the indications of different instruments of similar type strictly comparable, instrumental errors ought to be determined for each *in situ*.

The *exposure* of anemometers is an important consideration in the case of all instruments alike, whether velocity or pressure. Eddies and upward currents caused by the deflection of the wind by walls, roofs, &c., may easily magnify or diminish the effect on the instrument, and therefore in this respect also there is need for uniformity and care. An open staging raised well above any building is probably the best kind of support an anemometer could have.

For certain purposes the velocity instrument has an important disadvantage in its inability to indicate, under its usual conditions, the extreme forces of wind. This is due to the necessarily contracted scale which for economic reasons has to be used. In the standard type 7,000 revolutions of the cups, equal to 50 miles of wind, produce a line only 2·75 ins. in length; the width of 60 minutes of the time scale being less than 0·4 inch. It is, therefore, evident under these circumstances that many most interesting facts connected with wind velocity must be completely lost. A squall of wind, unless it be very violent or last for several minutes, is masked in the general appearance of the trace and cannot be detected; and, indeed, it not unfrequently happens that when its squalliness has been the chief characteristic of a wind the anemogram fails to give any indication of it. For example, the squally character of the easterly gale of January 18th of this year will be fresh in the recollection of all, yet an examination of the Kew anemogram for that day fails to show many indications that the wind was other than steady and uniform in force. At Seaham on December 28th, 1879, although squalls were so frequent and violent as to damage the instrument, and to call for special remark by the observer, yet the trace is almost entirely devoid of any indication of the occurrence of more than a fresh wind with a maximum velocity of between 30 and 40 miles per hour. Instances do, however, occur in which the squalls are of sufficient intensity and last sufficiently long to affect the trace, and allow of an approximation to the maximum velocity being made, and I append tracings of one or two anemograms in which this is illustrated.

The first is from the Aberdeen instrument, and although the total record for 60 minutes is not more than 30 miles, the total in 2 minutes is 4 miles or 120 miles per hour, and in 5 minutes 5 miles or 60 miles per hour.

second example is from a Valencia anemogram, and gives in 8
a total of 4 miles, or 80 miles per hour; the total for 60 mins. being
miles.



third case is still more marked, and is taken from a Holyhead curve;
al for 60 minutes is only 20 miles, but half of that amount was
ed in one-sixth of the hour. The woodcut shows the trace for two
tive hours, and during that interval several instances of squalls are
own. In the fourth instance, taken from a Kew curve, the squall,
short, was sharp, and is well indicated by the trace, a portion of which
y parallel to the hour lines. The copies of the traces have been some-
larged from the originals for the sake of clearness.

shorter periods than those mentioned, still higher rates would, of
be obtained, and instances might have been quoted in which, for
minutes, rates much exceeding these are shown. I have, however,
err rather by being too low than too high in the rates I have given,
nough, owing to the character of the trace, these amounts cannot be
as *absolutely* correct, still I do not think they fall *below* the rates quoted.
ection with them I may state that Prof. Stokes, F.R.S., has recently
d a form of anemometer—which he has called a "Bridled" anemo-
-in which the wind, acting upon five cups, tends to twist them round,
revented from doing so by weights attached to the instrument, and
ave to be lifted as the cups revolve. The height to which the weights
d is therefore the measure of the strength of the wind, and is recorded
per carried upon a cylinder. The instrument is provided with an
ment for opening the time-scale at pleasure during gales; it has been
at Holyhead, and its record can therefore be compared with that of
inary velocity instrument at work near it. On comparing the two it

is seen that heavy gusts are always shown synchronously with the occurrence of the phenomena referred to on the trace of the ordinary instrument, and evidence is thus afforded of the fact that the appearance is really due to great accelerations of the speed of the cups, lasting some time, and not to any accidental instrumental defect.

There is nothing in the velocity anemometer to prevent its being used for indicating the *rates* of wind during small intervals of time, and some years ago I contrived an arrangement in which, by means of a governor attached to the shaft, or to a smaller one geared to the main shaft of the instrument, a trace somewhat similar in character to that of the pressure instrument was obtained. Cams, arranged to equalise and extend the scale of the instrument, were attached to the governor and acting upon shoulders raised a rack which gave motion to a wheel acting in its turn upon the recording pencil. I found by experiment that the cups were very quick in taking up an increase of velocity and equally prompt in slowing as the wind decreased, but I regret that I had no opportunity afforded me of making a fair trial of the instrument under proper conditions for thoroughly testing its efficiency.

A mistake which has been very generally made, and which has caused much misconception as to the real velocity attained by the wind, is to quote the number of miles actually completed in 60 consecutive minutes as the measure of its destructive force; and also to compare such *mean* velocities with estimated forces or recorded pressures made at certain *points* of time. Instances are by no means rare in which small hourly totals are recorded, but in which nearly the whole of the mileage was registered in a few minutes of the hour, and in such cases it is manifestly misleading to compare the total for an hour with an observation made at any one minute of the hour—in other words, to confuse the *rate* at a part of the interval with the total distance covered during the whole of the interval. Some of the most violent gusts of wind occur at times when the hourly totals are not particularly great, and indeed the fact which must be generally known that gusts are commonly followed by lulls, when the wind falls considerably below its apparent mean force, would lead us to expect in gusty winds a moderate total for such a period as an hour. During the storm in which the Tay Bridge was wrecked the hourly totals at Glasgow and Aberdeen were not at all large for a gale, and would of themselves afford no clue to the fact that during the interval velocities sufficient to overturn such a structure had been reached. A case in point is quoted by Capt. Toynbee in an account of a cyclone at Madras, printed in the Journal of this Society for 1870. The captain of a ship mentioned gave a force of 12 for the wind, and since vessels were dismasted and sad havoc made with them generally, he was probably very near the truth; yet the anemometer on shore gave a maximum of only 53 miles per hour, upon which Capt. Toynbee remarkes, this "may be partly accounted for by the fact that the curve from the Observatory only records the mean speed, whilst Capt. Donkin's opinion would be influenced by the force of the gusts;" to which I may add that since it was probably the "force of the gusts" which rendered the gale in any way remarkable, in omitting to

indicate it the instrument failed to record the most important feature of the gale. As a matter of fact, the register of a velocity instrument of the standard type is of little value as regards its *negative* information, since it is certain that a heavy gust may occur, sufficiently strong to do a great amount of mischief, and yet not be indicated on the anemogram owing to its transient character. It is important to bear in mind these considerations when using tables of equivalent velocities and estimated forces, or pressures of wind, which have been based on these hourly measurements of velocity.

Before concluding, it may be interesting to quote some high velocities extending over considerable intervals of time, and recorded by instruments of the standard type referred to in this Paper; they are remarkable as being amongst the highest recorded as having occurred in this country.

1869	Dec.	26	Holyhead		550	miles in	8	hours.	Average rate	69	miles per hour.
1876	Dec.	20–23	Aberdeen		4,100	,,	72	,,	,,	57	,,
,,	,,	,,	,,		1,428	,,	24	,,	,,	59½	,,
1877	Feb.	20	Holyhead		164	,,	2	,,	,,	82	,,
,,	Nov.	16	Sandwick		83	,,	1	,,	,,	83	,,
1880	Oct.	28	Seaham		80	,,	1	,,	,,	80	,,
1881	Jan.	18	Yarmouth		865	,,	12	,,	,,	72	,,
	,,		,,	3 to 4 p.m.	84	,,	1	,,	,,	84	,,
	,,		,,		45	,,	½	,,	,,	90	,,
	,,		,,		25	,,	¼	,,	,,	100	,,

In each of these cases the factor 8 has been used for the ratio of movement of the cups to that of the wind.

In connection with the Yarmouth record it is worthy of remark that after resisting the heaviest portion of the gale, one of the cups was blown away in a squall when the velocity for the hour was but little more than half what it was during the height of the storm.

In a hurricane at Bermuda, on August 25th, 1880, what would probably have been a most interesting record was lost owing to the roof of the house on which the anemometer was erected being blown away, the rain getting at the paper and destroying such of the trace as was already registered. I have to express my obligations to the Meteorological Council for permission to quote these examples from their records.

In conclusion, I think I have said enough to show that anemometry is not at present in a condition which can be considered satisfactory; many assumptions which have hitherto, upon insufficient data, been accepted as true, are clearly in need of modification or rejection; and the practical importance of the subject is such as to call for earnest attention to the whole matter.

DISCUSSION.

Mr. ROGERS FIELD agreed with Mr. Curtis that anemometry was in a very unsatisfactory state. He exhibited and explained a diagram similar to that printed in Vol. V., p. 212, of the 'Quarterly Journal,' but containing in addition the results of the experiments on a Kew Pattern Anemometer carried out in 1872 by Mr. Jeffery and Mr. Whipple with the steam Merry-go-round at the Crystal

Palace, and recently "unearthed" by Prof. Stokes. The most important experiments of Dohrandt were not those of 1874, referred to by Mr. Curtis, but the later ones of 1878; and when these were compared with the experiments at the Crystal Palace and with those of Dr. Robinson at Rathmines, the most remarkable agreement was found to exist between them. This close agreement, he (Mr. Field) considered, placed it beyond doubt that Dr. Robinson's factor of 3, hitherto adopted in the construction of cup anemometers, was wrong, and that the correct factor was 2·40 or 2·45. This factor was moreover only right for high velocities—for low velocities no constant factor would apply, as the friction of the instrument then became a more important element.

He further pointed out that this error of 18 or 20 per cent. would account to a great extent for the discrepancies alluded to by Mr. Ellis between pressures calculated from maximum velocities registered by anemometers and pressures actually recorded by pressure plates. The pressures were as the squares of the velocities, and therefore an error of 20 per cent. in the registered velocity would introduce an error of between 35 and 40 per cent. in the corresponding calculated pressure. It was not creditable to meteorologists that errors of this magnitude should still be allowed to exist, more especially in a branch of science that had such an important practical bearing.

Prof. STOKES agreed with what had been said by the author of the Paper, and believed that we had now nearly got the true factor for Robinson's anemometers. The Crystal Palace experiments probably gave the factor a little too high, as no special precautions were taken to reduce as far as possible the friction. Different patterns of anemometers require their own proper factors. He conceived that the best position for a comparison of anemometers would be an open field, or, better still, the shore of a lake, while the roof of a building would not be a good position. With regard to the pressure exerted on a plate, the air would be at rest in the middle of the plate, and would glide off at the sides. According to theory, where the velocity is less than in the wind at a distance, the pressure is greater, where greater, less. In the middle, at any rate, there must be an excess of pressure, which, however, would become less towards the sides, where, as experiment shows, it is sometimes changed into a defect. However, on the whole there is an excess of pressure on the front face. The air rushing past the sides would get entangled with the air in the rear of the plate, and would tend to drag it with it, tending thereby to create a partial vacuum, so that there is a defect of pressure behind. The observed pressure is made up of the excess in front and the defect behind. Ordinary buildings could not withstand pressures shown by pressure plates. The "bridled" anemometer agrees in the character of its indications with the pressure plate.

Mr. WHIPPLE said that he had found that the velocity of the wind recorded by an anemometer on the top of a building 70 feet above the ground was from 20 to 40 per cent. greater than that indicated by one 15 feet above the ground. He was glad to hear that Dr. Dohrandt's experiments at St. Petersburg had been made with large anemometers; his first experiments, he believed, were made with a small instrument. There was always a great defect in the registration of direction with light winds—a serious point. He had recently watched the smoke from a bonfire, according to which the wind appeared to be dodging about through an angle of 120°; the anemometer close by showed that the very light breeze then blowing had not sufficient power to influence the vane. What was the use of recording the direction of the wind under such circumstances? He thought it desirable that observers should adopt a sign indicating calm when the velocity was under 3 miles per hour, instead of entering in their registers a direction which they knew to be probably incorrect.

Mr. MAWLEY thought that the author had given a very clear description of the unsatisfactory position in which we are placed at the present time as regards measuring the velocity and force of the wind. It seemed to him, however, somewhat superfluous to enter into a discussion as to what are the most perfect forms of instrument to use for these purposes, when there appears so little prospect of finding on land suitable positions in which to place them. In fact, differences in the indications of any two patterns would in most cases be more than counterbalanced by those due to influences dependent on the various modes of exposure available. From the Paper it might be inferred that the hourly values recorded by velocity anemographs very seldom give any indication that the force of the

wind had at any time been particularly great, whereas in reality precisely the reverse of this was the case. He (Mr. Mawley) had found the rate of revolution of the cups of a well exposed anemometer a good guide when estimating the force of the wind—much better than watching the movements of the upper branches of trees, which, of course, vary at different seasons. As regards very light winds, he agreed with Mr. Whipple in thinking that a vane which was sufficiently steady to work satisfactorily in a high wind would often give incorrect indications in very light airs. Indeed, under such circumstances, even smoke from neighbouring chimneys might occasionally be seen moving in diametrically opposite directions.

Mr. LECKY thought that anemometers were very unreliable when placed near the roofs of buildings, as the wind is deflected upwards, as was clearly shown by cattle going close to the edge of a cliff for shelter when the wind is blowing "on shore."

Mr. RUNDELL thought the divergence of the lines representing low velocities of the wind in Mr. Field's diagram had been properly attributed to instrumental friction. He had heard the complaint made against certain anemometrical records that they made calms of very frequent occurrence, while at Liverpool, both at the old observatory and at Bidston, the cups of the anemometers were very rarely at rest, only a few hours of calm being recorded in the course of a year. Variability in direction was not, he considered, the exclusive character of light winds. Certain strong winds constantly oscillated through a considerable angle while keeping a generally uniform direction, and he believed it would be found that these oscillations were nearly synchronous over very large areas. In respect to the influence of size on the pressure-plate of an anemometer, the high pressures recorded at Bidston had been attributed to the large size of the plate. Greater pressures, however, had been recorded since it had been reduced from 3 to 2 feet in diameter than before. This may not be due to the reduction in the size of the plate. It must be remembered that experienced yachtsmen are of opinion that with a given area of canvas the best results are obtained when it is used as one sail and not when it is divided into two or more sails. Careful experiments on wind pressure upon large areas were much wanted. At the recent meeting of the Institute of Naval Architects it was stated that as yet no experiments appear to have been made on surfaces larger than a handkerchief.

The PRESIDENT (Mr. Symons) said that the late Mr. Cator endeavoured to overcome the diminution of pressure at the back of the plate by fixing a cone to the rear of the plate. The question of the error in the factor for velocity anemometers, was another lesson on beginning at the wrong end. Beginning, that is to say, without sufficiently positive truth of the infallibility of the instrument, and of the conclusions drawn from its indications. It was very desirable that there should be uniformity with regard to the registering, position, oiling, and cleaning of anemometers. He did not agree with Mr. Curtis that anemometers should be mounted on a platform above buildings, as the buildings themselves would greatly affect the wind; he thought that the best exposure would be at the top of a pyramid or cone. He strongly approved of the suggestion that two definite patterns of anemometers should be adopted and no others used.

Mr. CURTIS wished to explain, with reference to a remark of the President, that he did not advocate the erection of anemometers on the roofs of houses if eligible sites could be otherwise obtained; but since in the majority of cases, in rural as well as urban districts, close proximity to a house was unavoidable, he considered that under such circumstances the best result would be obtained by raising the instrument well above the house on an open framework such as would offer the least resistance to the wind. He was indebted to the kindness of Mr. E. T. Dowson, of Geldeston, for a copy of the hourly velocities recorded on the 18th of last January by the anemometer erected on the roof of the Free Library in the centre of the City of Norwich, from which it appeared that the maximum number of miles registered in an hour during the storm was 32, at the same time that the Yarmouth instrument recorded 84, and during the twelve hours in which the latter registered a total of 865 miles, the Norwich instrument indicated only 321 miles—averaging but 26¾ miles per hour; this fact emphasised the importance of what had been said relative to the necessity for uniformity in type of instrument and conditions of exposure in order to render anemometrical results comparable. He might add that it was characteristic of the *direction* trace pro-

duced by the arrow-vane that in light winds the oscillations were very large and apparently erratic, the windmill-vane commonly giving a straight line at such times ; in strong winds both vanes gave a broad blurred line made up of small oscillations on either side of the mean point, and in the windmill-vane the line would probably average about two points in breadth.

The use of Synchronous Meteorological Charts for determining mean values over the Ocean. By Charles Harding, F.M.S. (Plate X.)

[Read June 15th, 1881.]

The discussion of observations from ships' logs presents numerous difficulties altogether foreign to land observations, although at the same time there are certain principles which must be rigidly adhered to in the discussion of both.

In obtaining a mean at a land station, say for a month, certain fixed hours of observation are selected and the final mean is struck, due regard being paid to the continuity of the observations, seeing that each day is represented and that the same hours are used for each day.

The same principle is not attempted in the discussion of sea observations. A ship is a constantly shifting observatory, recording an observation in one spot to-day, while on the following day she may have moved a considerable distance and have entered a different area of observation. It is only by grouping together a sufficiently large number of observations for a fixed area that any thing like a fairly correct result can be obtained. Inasmuch as in marine meteorology the important consideration for the navigator, when making a certain passage, is, Shall I go North, or shall I go South ; shall I go East, or shall I go West ? it is of primary importance that the results given for the different geographical positions should be as nearly as possible comparable one with another.

The object of the present Paper is to exhibit a method of obtaining averages from observations made on board ship, which has considerable advantages in its favour on account of its eliminating many of the difficulties which exist in the ordinary methods followed in the discussion of ocean meteorology.

The methods usually followed have so frequently been described in the Reports of the Meteorological Office that but a few words of explanation will here be given to convey broadly the principles on which they are based.

It will be evident at once that, taking for example the discussion of the meteorological elements for the North Atlantic Ocean, it is only possible to get an occasional observation in any fixed position. The method hitherto adopted for obtaining mean results is to select a space having a fixed area, say a 5° square, *i.e.* a space comprising 5° of latitude and 5° of longitude, and to use all the observations recorded in this space for obtaining a mean result. The same is done for all other 5° squares, and the results thus obtained are necessarily treated as comparable.

In the discussion by the ordinary method there is a decided advantage in

grouping the observations into rather large spaces, since by so doing the number of observations is necessarily augmented and the value of the result consequently increased—for if, for sake of example, we take a single-degree square instead of a five-degree square there would be 25 means instead of 1, and the number of observations available for each lessened proportionately. In the most crowded parts of the ocean the material for determining the values of such minute districts is not sufficient, nor is it ever likely to be so, but by working on larger spaces isobars (if dealing with the barometer) can be drawn, by the aid of which the values can be read off for any space required, however minute.

Whatever sized space is chosen, the result deduced may be obtained from the observations of different ships and made in quite different years and under very different conditions from those in the adjacent space with which comparison is made. Indeed the means of sea observations are made up from a certain number of snatches of observations, here one observation, recorded during a gale, giving a very low reading of the barometer, and there, in the adjacent space, possibly no record in a gale at all. From this method of treatment it is evident that in a part of the world where the conditions are very changeable, it is only by the massing together of a large number of observations, extending over many years, that any approach to a reliable mean can be obtained.

The discussion of the weather of the North Atlantic for August, 1873, by the Meteorological Office,* has afforded an opportunity of testing another method of obtaining mean results, and although other synchronous Weather Charts have been published, the data used, in my opinion, have not been sufficiently numerous to warrant the present method being applied to them.

Captain Toynbee's discussion gives a synchronous chart for the whole of the North Atlantic and neighbouring continents for 0h. 43m. p.m. Greenwich time, each day throughout the month, as obtained from the logs of about 280 vessels. Observations from about 150 vessels have been used each day, in addition to the records from many land stations.

For each of these synchronous charts isobars have been drawn for the whole of the North Atlantic, and for the working of the present paper these isobars have been used for obtaining a reading of the barometer at the centre of each 5° square for each day throughout the month, and from these daily values a mean has been obtained for each 5° space for the whole month. It will thus be seen that all the means obtained in this manner are strictly comparable with each other, as much so as if the observations of fixed stations on shore were being compared.

To illustrate more clearly the method of working, I shall explain the process followed in this Paper by reference to the official Daily Weather Chart. On May 15th the barometer at London was 29·84 ins., and at Holyhead 29·56 ins.; by the aid of these and other stations isobars are drawn by pro-

* The Meteorology of the North Atlantic during August, 1873; by Captain Henry Toynbee, with 31 Synoptic Charts. London, 1878.

pricking out the difference of barometer over the intervening space, and from these isobars the barometer reading at any intermediate spot between London and Holyhead can be obtained with a fair approximation to the truth. On this day the barometric gradient was pretty uniform between the two stations, so that the barometer at a place situated half-way between them, say at Worcester, would be 29·70 ins. It is exactly in this way, by reading off from the isobars at the required spot of observation (the centre of each five-degree square), that the individual observations of each day have been obtained.

Of course it will be urged that we have here only the mean for one month in one year, and that the conditions might have been very different in other years. Doubtless there is considerable truth in this, but I maintain that as far as relative results are concerned the means for this single month are more comparable than those from the observations of many years worked in the ordinary way, and by combining with these results those of other years obtained in a similar manner, most reliable averages could be obtained. Hoffmeyer's series of Synchronous Charts for the North Atlantic contains daily observations for August, 1874, 5, and 6, but the labour of producing a monthly chart from these for each day is too great to be undertaken by a private individual, and especially by one with only a limited time at his disposal; at the same time it is doubtful whether the observations used in these charts are any thing like sufficient to allow of the isobars being drawn with a sufficient degree of accuracy to ensure a correct result. By this it must not be understood that I in any way wish to undervalue Captain Hoffmeyer's charts, or to differ in the least from the methods followed, but the data used were evidently insufficient. M. Le Verrier also brought out a series of daily Synchronous Charts for 1865 and part of 1864 in his *Atlas des Mouvements Généraux de l'Atmosphère*, embracing the North Atlantic north of 40° N. The data used for these charts were also insufficient. The charts to which we may look with some degree of confidence are those now in course of publication by the Signal Office of the United States Government, for the construction of which the international series of synchronous observations are used; these will doubtless afford material for this kind of work; but the only *monthly* chart for August at present published is that for 1878, one of the series which appeared in '*Nature*,' but this special chart is of doubtful value, probably owing to the want of more observations, and I have not yet seen any statement as to how these monthly charts are obtained, so that at present it is felt that no other observations exist which are available for combining with those deduced from the publication by the Meteorological Office. As before stated, the number of ships observing each day over the Atlantic for the charts of August, 1873, was about 150, and it is evident that a smaller number than this is not sufficient to give reliable results. Such a large number of observations can only be obtained by a public department, and then only by a special effort which would be easiest made by a nation having a large trade on the Atlantic, such as Great Britain.

The chart (Plate X.) gives the mean barometer for the centre of each 5° square in the North Atlantic between the latitudes of 15° and 55° N., also the isobars drawn from these mean values for the month of August 1873, so that the reading of the barometer can be obtained for any spot in the Atlantic by reading off the value shown by the isobars.

An observation was omitted in striking the mean which was materially influenced by the hurricane which was tracked from near the Cape Verd Islands on the 12th to the west of Bermuda on the 22nd, and finally crossed Newfoundland on the 27th.

Although the Synchronous Charts extend to the Equator, it was not considered safe to attempt to deduce the means to the south of 15° N., since but few isobars are given for this part, and August is the month in which the Doldrum is at its most northern limit, extending to about 12° N.; this would tend to increase the difficulty of obtaining the mean values unless the chart embraced some portion of the South Atlantic.

With the view of comparing the results which are obtained by the method followed in this Paper with the ordinary method of obtaining means at sea, a few squares have been selected hap-hazard and dealt with in the ordinary way, *i.e.* striking an average from all the observations recorded in a certain space, in this case a 5° square. The spaces selected are those between 35° and 45° N., and 30° to 45° W., which boundaries contain six five-degree squares.

By the method suggested in this Paper, *i.e.* using each day's observations approximated by aid of the isobars drawn, we get:—

	West Longitude.		
	45°—40°	40°—35°	35°—30°
	Ins.	Ins.	Ins.
Latitude 45°—40° N.	30·21	30·25	30·29
„ 40—35 N.	30·28	30·32	30·34

By the ordinary method, *i.e.* using the actual observations recorded, we get—

	West Longitude.		
	45°—40°	40°—35°	35°—30°
	Ins.	Ins.	Ins.
Latitude 45°—40° N.	30·17	30·32	30·19
No. of Days' Observations.....	13	5	7
Latitude 40°—35° N.	....	30·38	30·30
No. of Days' Observations	0	10	4

The results by the former method bear evidence by the range of the figures of being by far the preferable.

To test how far the month here dealt with represents the average conditions of August, I have compared the means deduced from the observations of 1873 with the averages for August deduced from several years' observations. In the first place making a comparison with the mean barometer values published by the Meteorological Office for 15° to 20° N., and 15° to

W., in their discussion of the Nine Ten-degree Squares in the Atlanti uatorial District, we get :—

	West Longitude.					
	40°—35°	35°—30°	30°—25°	25°—20°	20°—15°	
Latitude 15°—20° N.	Ins. 30·04	Ins. 30·02	Ins. 30·01	Ins. 29·97	Ins. 29·92	Synchronous Method, August 1873.
	30·03	30·02	30·00	29·96	29·94 (poor, only 16 obs.)	Ordinary Method, about 16 years.

For the values obtained for August 1873, only 41 observations wer recorded, whilst for those by the ordinary method 1,053 observations wer used. This comparison is, however, for a part of the sea where very littl change takes place in the height of the barometer.

The following gives a similar comparison for the American Stations on th western borders of the Atlantic, using the mean values published in th Report of the Chief Signal Officer; also for the European and othe stations, using the records from the observatories of the Meteorologica Council and Buchan's observations:—

	Station.	Lat. N.	Long. W.	Barometer.		
				Aug. 1873.	Aug. for several years.	Diff. of Aug. 1873 on average.
		° ′	° ′	Ins.	Ins.	In.
American Stations.	Eastport	44 55	66 54	30·04	30·01	+·03
	Portland	43 40	70 14	30·03	30·03	·00
	Boston	42 21	71 4	30·06	29·94*	+·12*
	New York	40 43	74 0	30·07	30·04	+·03
	Cape May	38 56	74 58	30·05	30·02	+·03
	Norfolk	36 51	76 19	30·07	30·05	+·02
	Charleston	32 45	79 55	30·08	30·04	+·04
	Jacksonville	30 24	81 40	30·07	30·05	+·07
	Punta Rassa	27 0	82 18	30·09	30·06	+·0
	Key West	24 32	81 48	30·06	30·01	+·0
European Stations.	Armagh	54 21	6 39	29·86	29·90	—·0
	Stonyhurst	53 51	2 28	29·86	29·89	—·
	Valencia	51 55	10 18	29·90	29·96	—·
	Kew	51 28	0 19	29·97	29·98	—
	Falmouth	50 9	5 4	30·00	30·02	—
	Lisbon	38 43	9 8	30·12	30·06	+
	Gibraltar	36 7	5 21	30·03	29·99	+
Atlantic Stations.	Funchal (Madeira)	32 38	16 56	30·14	30·10	·
	Bermuda	32 23	64 40	30·16	30·22	
	Nassau	25 4	77 22	30·10	30·07	

* Clearly some mistake exists in the average at Boston.

The small differences shown to exist between the means for Aug and those for August for several years would certainly seem to sho values deduced from this single month represent very fairly t conditions of the barometer for that month, and in the absenc

means for certain unfrequented parts those given in this Paper may prove of value.

The German Meteorological Office is discussing the belt of the North Atlantic which lies between 20° and 50° N., and the two volumes already published afford the following comparison for the barometer observations :—

The results worked for this Paper give for August 1873—

	West Longitude.			
	30°—25°	25°—20°	20°—15°	15°—10°
	Ins.	Ins.	Ins.	Ins.
Latitude 45°—50° N.	30·17	30·16	30·13	30·08
„ 40 —45 N.	30·29	30·26	30·22	30·16

The German discussion, by the ordinary method of obtaining means from marine observations, gives for August from several years' observations :—

	West Longitude.			
	30°—25°	25°—20°	20°—15°	15°—10°
	Ins.	Ins.	Ins.	Ins.
Latitude 45°—50° N.	30·06	30·03	30·03	30·03
„ 40 —45 N.	30·14	30·06	30·02	30·07

These results are in very poor agreement with each other, but the run of the figures in the German discussion would seem to leave room for doubt as to their accuracy, although on the other hand the figures for August 1873 may be somewhat too high.

When commencing this Paper it was my intention to have dealt in a similar manner with the winds and air temperature, both of these elements being also given on the Synchronous Charts published by the Meteorological Office. The winds were fairly commenced, but the amount of labour was so great that I ultimately abandoned the idea; but suffice it to say that doubtless a similar discussion of the winds would have shown a well-defined anticyclonic circulation round the area of high pressure which is situated in Mid-Atlantic.

In the letterpress which accompanies the Synchronous Charts, which have been used for this discussion, Captain Toynbee, in speaking of the area of high pressure in the centre of the Atlantic, calls attention to the manner in which the wind circulates round this high pressure, and follows the direction of the isobars, but drawing slightly out from the centre.

It is not necessary for me to remark here on the great importance of Synchronous Charts for the elucidation of weather changes, but if I have shown that such charts are also of value for the building up of reliable mean results this must prove an additional argument for the carrying out of that special style of work.

Note.

In the course of the discussion which followed the reading of this Paper, Mr. Scott drew attention to a similar method having been recommended by Captain Hoffmeyer in a paper read at the International Meteorological Congress, held in Paris, August 1878. I had not seen that paper, but it is satisfactory to find that I have independently arrived at the same conclusion as Captain Hoffmeyer. I have for many years had the subject matter in

my mind (see the discussion which followed one of Mr. Abercromby's papers, read in April 1878 and printed in the *Quarterly Journal*, Vol. IV. p. 157).

DISCUSSION.

Mr. ARCHIBALD said, that though the results obtained from the method employed by Mr. Harding for August, 1873, showed a remarkable agreement with those got by the ordinary method based on 16 years' observations, he thought this was rather a proof of the remarkable constancy of the barometric conditions over the Atlantic during August from year to year, than of the superiority of the method employed. On comparing Mr. Harding's results for 1873 with those obtained from 16 years' observations, it appeared that a large anticyclone usually prevails over the North Atlantic in August, and that in 1873 the centre of this anticyclone was rather to the west of its ordinary position.

Mr. LAUGHTON was inclined to think, with Mr. Archibald, that the agreement obtained by the two methods, as shown by Mr. Harding, was fortuitous. It seemed to him that the mean of many observations, taken promiscuously at all hours of the twenty-four, is more likely to be correct than that found by few observations, taken at a fixed time (7 h. 35 m. a.m. Washington time), which over the extent of the Atlantic varies by about six hours of local time, and involves therefore very considerable differences of correction for diurnal range.

Mr. SCOTT said that Capt. Hoffmeyer, in a paper read before the Meteorological Congress at Paris, in 1878, of which a translation was published in the *Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie*, Vol. xiii. p. 337, had employed the same method as Mr. Harding. He himself considered that by this method of obtaining mean values from a series of simultaneous observations plotted on charts for a month barometrical means could be obtained from districts of the sea which lie out of the ordinary track of ships. No one who had not had practical experience of marine meteorological discussions could realise how difficult it was to obtain information uniformly distributed over the area under discussion from time to time, owing to the fact that ships kept in regular tracks, leaving other parts utterly unvisited.

Mr. STRACHAN said it was unnecessary to institute a comparison of synoptic means with ordinary averages, as the two methods are distinct and fulfil different purposes. The United States Signal Office publish a synchronous meteorological chart for each day, and likewise a chart of the monthly average conditions. The monthly charts must be drawn from synoptic means, that is from the means of data extracted from the daily charts, in the manner very clearly explained by Mr. Harding. If they were not compiled in this manner he should very much doubt their value. If it were possible to get a continuous supply of observations this method of meaning would be very valuable, as it would enable them to compare the weather of one month with that of another, and finally one year with another year. Given synoptic daily charts, there was no other method of averaging their conditions. He had himself used the Daily Weather Charts for this identical purpose for many years. The time had now arrived, when so much synoptic work being done, the method of deducing synoptic means must come into general use, and therefore Mr. Harding had done good service in directing the attention of the Society to it. He regarded it as one of the best papers read to them for a long time.

The PRESIDENT (Mr. Symons) said that some of the charts published by the United States Signal Office, giving the isobars over the whole of the North Atlantic, must be very fallacious, as they were based only on about twelve observations. When a sufficient number of observations could be obtained to draw isobars, he considered that the synchronous method would be decidedly the best. The difficulty was in getting the materials.

THE CLIMATE OF FIJI: RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT DELANASAU, BUA, VANUA LEVU, FIJI, 1871-1880. By R. L. HOLMES, F.M.S.

[Read June 15th, 1881.]

As a further contribution to the little known meteorology of the South

Pacific, and of England's youngest colony, I beg to lay before the Society an abstract of observations taken by me at Delanasau, Bua, Fiji, during the five years ending December 31st, 1880; and I have appended thereto the principal results for the five years previous, namely, from 1871 to 1875, forming an unbroken series extending over ten consecutive years.

In my former report* the position of the station, the instruments, &c. were fully described, but it may be desirable to repeat here some of the particulars.

Delanasau lies in the Province of Bua, north-west district of Vanua-Levu, the second largest island of the Fiji group. This island is 105 miles long, with an average width of about 25 miles. It runs in an ENE and WSW direction, or almost at right angles to the course of the prevailing SE trade winds. The whole island is more or less hilly, with a few conspicuous peaks towards the centre rising over 3,000 feet above the level of the sea; and the greater part is covered with forest, particularly the southern, or windward and wetter portions. The geological formation is principally volcanic, with occasional patches of sedimentary strata of tertiary origin. Alluvial flats extend along most of the rivers, and coral reefs of every description abound in all directions round the coast. The homestead at Delanasau lies one mile back from the sea, on a low hill overlooking a flat through which runs the Lekutu river. The immediate neighbourhood consists of downs or low undulating hills, lightly timbered except along the watercourses, but well clothed with grass, fern, &c.; and is intersected by numerous creeks, with an occasional swamp, but no lakes. The house has a NW aspect, overlooking the bay with its many islands, rocks, and reefs. Ten miles off shore, after heavy northerly weather, the sea may be observed breaking on a coral reef that runs almost the entire length of this island, approaching the coast more to eastward. The coast-line in the neighbourhood varies much in character, from cliffs or rocky hills rising abruptly out of the water, to open sandy or shelly beaches, and long stretches of mangrove swamps or salt marshes. The latter abound mostly in the river estuaries, and along the banks as far up as the tide extends. Inland, at a distance of about five miles, there is an abrupt rise of about 500 feet, which divides the open country of this coast from the mountainous, forest-covered portion that prevails on the southern and larger part of the island. A direct line in a SE direction from the station strikes the opposite coast at a distance of about 25 miles, near Savu Savu Bay. To the north, after passing the neighbouring small islands and reefs, an open sea prevails, with only far-distant, and in size insignificant islands, between this and the NE part of Asia, near Behring's Straits. To the W and SW, approaching to within four miles, are also extensive forests covering high hills.

Instruments—their position, &c.—There has been no change in the position of the louvre-boarded screen containing the maximum and minimum thermometers, and the hygrometer, which is suspended under the verandah, having

* See *Quarterly Journal of the Meteorological Society*, Vol. III. pp. 260-277.

a NW aspect. The corrugated iron roofing is protected from direct sunshine by a thick coating of jasmine and granadilla vines, and other foliage, but the air circulates freely around and through the screen. The rain-gauge and solar thermometer are placed a little distance away, clear of all trees, buildings, &c. The barometer is suspended in the house, the doors and windows being nearly always open in the day time, and one or more of the windows always open at night.

The thermometers are by Casella; rain-gauge by Negretti and Zambra, 4 inch, circular, orifice 28 inches above ground; hygrometer (dry and wet bulb) by Newman, carefully compared; mercurial barometer, No. 1116, by Negretti and Zambra: this fine instrument was received in 1878, consequently only two complete years' returns are available as yet. It was compared with the standard at the Sydney Observatory by Mr. H. C. Russell, the Government Astronomer, and through it with the Kew standard: it requires a total correction for index error of —0·007 in.: the cistern is fixed 75 feet above mean sea level.

It is almost needless to remark that the caution expressed in the previous report, referring to the doubtful character of the aneroid returns, was fully confirmed on the arrival here of the mercurial barometer, when the aneroid was found to read 0·42 in. in excess. The error had gradually increased during 7¼ years from zero in 1870, when it was adjusted to the standard barometer in Wellington, New Zealand.

Hours of Observation.—These were 9 a.m., 8 p.m., and 9 p.m. daily; at 9 a.m. all the instruments were read off, and at 8 and 9 p.m. the barometer and attached thermometer were again recorded. In completing the day's returns each evening, additional descriptive columns were filled in for the following:—Hours of rainfall, by day or by night; the occurrence of thunder or lightning; hours of clear sunshine (estimated); direction and force of wind (scale 0—12); lastly, general remarks.

TABLE I.—Atmospheric Pressure.

1879.	Monthly Mean. 9 a.m. 3 p.m.	9 a.m.	3 p.m.	9 p.m.	Maximum observed.	Minimum observed.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
January ..	29·825	29·846	29·804	29·853	29·946	29·729
February ..	·825	·854	·797	·864	29·967	·725
March	·871	·906	·837	·903	30·027	·734
April	·910	·950	·871	·938	·004	·821
May	·928	29·968	·889	·959	·058	·796
June	·978	30·015	·941	29·992	·113	·845
July	29·990	·030	·950	30·010	·141	·862
August	30·007	·046	·968	·018	·127	·882
September..	29·987	30·025	·949	30·009	·082	·901
October	·947	29·985	·910	29·976	30·091	·805
November ..	·885	·918	·852	·906	29·971	·806
December ..	29·780	29·807	29·754	29·812	29·950	29·406
Means and Extremes	29·911	29·946	29·877	29·937	30·141	29·406

TABLE II.

1880.	Monthly Means. 9 a.m. 3 p.m.	9 a.m.	3 p.m.	9 p.m.	Maximum observed.	Minimum observed.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
January ..	29·721	29·746	29·695	29·749	29·881	29·529
February ..	·813	·842	·784	·849	29·914	·650
March	·858	·892	·824	·893	30·020	·596
April	·891	·933	·850	·920	·030	·760
May	·939	·977	·902	·962	·035	·838
June	·940	29·979	·902	·964	·048	·815
July	·960	30·000	·920	29·982	·059	·842
August	·975	·015	·935	30·002	·110	·815
September..	·965	30·006	·924	29·993	·095	·802
October	·948	29·985	·911	·970	·074	·758
November ..	·885	·914	·857	·917	30·038	·734
December ..	29·826	29·852	29·800	29·858	29·976	29·620
Means and Extremes	29·893	29·928	29·858	29·922	30·110	29·529

	Ins.
Mean Pressure of the Atmosphere, 2 years (1879-1880)	29·902
Extreme Range observed in 1879	0·735
Extreme Range observed in 1880	0·581

The following are the only instances, in the two years, when the 3 p.m. Pressure of the Atmosphere equalled or exceeded that at 9 a.m. or 9 p.m.:—January 29th, 1880, at 9 a.m. and 3 p.m., pressure equal; May 16th, 1880, at 3 p.m. and 9 p.m., difference 0·001 in. only; November 29th, 1880, at 3 p.m. 29·963 ins., at 9 p.m. 29·960 ins.

TABLE III.—Temperature of Air in Shade.

	5 years—1876-1880.					5 years—1871-1875.			
Month.	Mean.	Absolute Max.	Absolute Min.	Mean Daily Range.	Mean Monthly Range.	Mean.	Absolute Max.	Absolute Min.	
	°	°	°	°	°	°	°	°	
January	81·0	98·6	68·8	13·6	23·6	80·1	97·7	67·0	Mean Daily Range .. 15·6
February	80·9	95·2	68·6	13·1	21·6	80·0	94·3	68·2	
March	80·8	96·8	68·8	14·4	23·5	79·8	97·5	68·5	
April	80·2	92·7	65·2	13·9	23·3	79·5	92·4	67·5	
May	79·2	91·5	64·0	15·6	25·5	79·1	96·5	60·0	
June	77·9	91·8	59·5	16·3	27·4	77·9	92·0	59·3	
July	76·7	92·0	59·0	17·1	29·5	77·3	91·7	61·3	
August	77·1	91·2	56·7	15·1	28·3	77·4	91·0	58·5	
September ..	77·5	93·0	56·3	18·0	30·2	78·1	92·8	61·7	
October	79·0	95·8	60·2	17·4	29·4	79·4	94·5	62·0	
November	79·8	94·0	65·4	16·3	25·5	80·0	94·6	64·0	
December	81·7	97·6	68·0	15·2	25·3	80·7	94·4	68·5	Mean Monthly Range 26·1
Means and Extremes	79·3	98·6	56·3	15·5	26·1	79·1	97·7	58·5	

TABLE IV.—Temperature of Air in Shade.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly Means.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1876	80·7	80·9	80·5	80·4	79·0	78·5	76·6	78·4	78·1	78·0	80·0	80·5	79·3
1877	80·0	81·3	81·8	80·5	79·7	76·6	74·7	75·0	75·0	78·7	79·9	84·1	78·9
1878	83·9	83·4	82·8	80·4	79·5	77·3	77·0	76·9	79·5	80·1	80·3	83·7	80·4
1879	79·9	79·0	81·6	80·0	79·1	78·9	78·2	77·2	77·6	79·1	79·5	79·8	79·1
1880	80·5	79·8	79·9	79·6	78·6	78·0	77·1	78·1	77·2	78·9	79·3	80·2	78·9

TABLE V.—Highest Temperature in each Month.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Max.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1876	91·9	92·6	91·8	91·8	91·3	91·8	92·0	91·2	91·4	91·8	94·0	97·0	97·0
1877	93·8	93·8	94·7	90·8	91·5	89·2	87·4	88·4	89·8	95·8	93·6	97·6	97·6
1878	98·6	95·2	94·8	92·2	90·6	89·3	90·8	89·1	92·8	94·5	93·3	94·8	98·6
1879	92·4	91·8	96·8	92·7	90·6	90·4	90·2	90·8	89·4	93·7	91·0	91·4	96·8
1880	92·7	89·6	92·5	91·6	89·6	89·8	88·0	88·8	93·0	91·9	90·8	90·4	93·0

TABLE VI.—Lowest Temperature in each Month.

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Min.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1876	68·8	71·3	70·6	65·2	64·4	62·5	60·2	65·0	60·0	62·7	66·6	68·0	60·0
1877	69·2	72·2	68·8	71·2	64·0	59·5	59·3	56·8	56·3	60·2	68·0	70·8	56·3
1878	72·3	73·3	72·0	70·8	64·9	61·7	59·1	56·7	65·2	66·2	67·4	68·4	56·7
1879	70·1	69·8	71·7	69·6	66·3	64·4	63·1	63·2	63·3	64·6	68·0	68·0	63·1
1880	70·8	68·6	70·1	66·0	66·6	65·6	59·0	65·2	60·8	67·0	65·4	69·6	59·0

TABLE VII.—Mean Daily Range of Temperature.

													Mean.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1876	14·3	13·0	13·3	16·6	14·5	17·4	21·3	17·4	17·0	17·1	17·5	16·1	16·3
1877	13·3	12·9	16·5	12·0	18·3	15·7	15·3	13·5	19·5	20·0	18·0	18·8	16·1
1878	14·1	14·1	13·3	13·8	15·3	18·2	16·9	18·0	19·2	1 ·5	16·2	13·1	15·8
1879	13·0	12·0	14·9	13·7	15·6	15·3	16·9	17·2	15·9	16·8	15·4	15·0	15·1
1880	13·2	13·5	13·8	13·2	14·3	14·9	15·1	14·5	18·2	15·7	14·6	13·2	14·5

TABLE VIII.—Monthly Range of Temperature.

													Mean.
	°	°	°	°	°	°	°	°	°	°	°	°	°
1876	23·1	21·3	21·2	26·6	26·9	29·3	31·8	26·2	31·4	29·1	27·4	29·0	26·9
1877	24·6	21·6	25·9	19·6	27·5	29·7	28·1	31·6	33·5	35·6	25·6	26·8	27·5
1878	26·3	21·9	22·8	21·4	25·7	27·6	31·7	32·4	27·6	28·3	25·9	26·4	26·5
1879	22·3	22·0	25·1	23·1	24·3	26·0	27·1	27·6	26·1	29·1	23·0	23·4	24·9
1880	21·9	21·0	22·4	25·6	23·0	24·2	29·0	23·6	32·2	24·9	25·4	20·8	24·5

TEMPERATURE IN THE SHADE.*
Summary for 10 years.

Maximum, on January 6th, 1878	98°6
Minimum, on September 14th, 1877	56·3
Extreme Range	42·3
Highest Mean Temp in 24 hours, January 6th, 1878	88·5
Lowest Mean Temp. in 24 hours, August 3rd, 1873	65·9
Greatest Range in 24 hours, October 9th, 1877	30·6
Least Range in 24 hours, March 31st, 1877	2·4
Mean Daily Range	15·5
Mean Monthly Range	26·1
Mean Yearly Range	36·5
Mean Temperature	79·2

* The Temperature in Shade reached or exceeded 90°0—

In 1876	56	times
In 1877	90	,, (including 28 times in December!)
In 1878	105	,,
In 1879	39	,,
In 1880	21	,,
Average per annum for 5 years	62	,,

TABLE IX.—RAINFALL.

Month.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.	Mean.
	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
January	35·90	25·31	20·15	24·85	22·23	12·30	41·70	10·46	25·89	24·17	24·30
February	17·30	19·14	17·31	12·14	17·89	21·54	13·46	7·40	19·62	18·24	16·40
March	36·32	13·39	16·52	12·59	49·88	21·57	7·22	10·51	7·83	21·67	19·75
April	11·34	14·76	11·38	9·36	9·42	6·67	5·65	6·04	8·01	7·97	9·06
May	8·57	7·17	4·53	5·01	3·63	5·75	0·83	2·08	3·98	5·94	4·75
June	1·50	6·63	2·51	1·70	3·49	0·67	0·86	0·01	5·23	1·04	2·36
July	1·05	0·36	4·71	0·46	1·63	0·05	5·52	2·18	2·83	1·74	2·05
August	8·91	6·35	8·10	4·00	1·08	3·41	2·30	1·07	0·96	1·88	3·81
September ..	9·98	3·59	1·47	6·63	2·61	2·44	0·41	0·17	4·22	1·72	3·32
October	6·68	5·06	7·03	11·74	5·32	5·78	1·29	3·45	7·63	10·57	6·45
November	12·98	10·53	2·88	5·82	3·22	2·04	0·48	7·46	8·36	10·04	6·38
December	8·98	14·74	7·51	9·18	6·24	9·14	0·81	6·04	10·60	10·63	8·39
Sum	159·51	127·03	104·10	103·48	126·64	91·36	80·53	56·87	105·16	115·61	107·02
Greatest Fall in 24 hours each year	14·95	5·05	2·82	4·85	7·65	5·73	12·08	2·45	4·66	7·78	..

TABLE X.—RAINFALL IN 10 YEARS.

Month.	Greatest Monthly Fall.	Least Monthly Fall.	Greatest Fall in 24 hours.	Days on which Rain fell exceeding 0·01 ins.			Average No. of hours of rainfall (9 years—1871 excluded).
				Mean.	Max.	Min.	
	Ins.	Ins.	Ins.				
January	41·70	10·46	12·08	22	26	16	91
February	21·54	7·40	5·56	19	23	14	66
March	49·88	7·22	14·95	20	27	13	70
April	14·76	5·65	4·70	17	22	11	38
May	8·57	0·83	3·51	10	13	6	22
June	6·63	0·01	3·90	6	10	1	10
July	5·52	0·05	3·50	6	14	2	12
August	8·91	0·96	2·67	8	13	4	18
September ..	9·98	0·17	3·59	9	13	2	15
October	11·74	1·29	2·80	11	16	4	27
November	12·98	0·48	5·52	11	16	3	23
December	14·74	0·81	2·90	16	22	2	36
Means and Extremes	49·88	0·01	14·95	155	27	1	428

	Ins.
Mean Annual Rainfall	107·02
Greatest Yearly Fall, in 1871	159·51
Least Yearly Fall, in 1878	56·87
Greatest Monthly Fall, March 1875	49·88
Least Monthly Fall, June 1878	0·01
Greatest Daily Fall, on March 19th, 1871	14·95

Average No. of days on which rain fell, 155. Extremes: 181 days in 1873, and 106 days in 1877.

Average No. of hours of rainfall (9 years) 428. Extremes: 502 hours in 1872, and 249 hours in 1878.

SOME NOTEWORTHY FALLS OF RAIN IN 5 YEARS, 1876-1880.

(For similar statistics for the years 1871-1875, see previous Report.—*Quart. Jour.* Vol. III. p. 264.)

		Ins.
1876.	In 1h. 30m. on April 23rd	2·25
1877.	In 74 hours ending 8 a.m. January 29th (including 9 ins. in 11 hours on the 27th)	27·32
„	In 1h. 30m. on March 27th	2·10
1879.	In 1h. on January 24th	1·23
„	In 1h. on January 26th	1·72
„	In 0h. 45m. on November 25th	1·58
1880.	In 1h. 30m. on January 15th	2·01
„	In 0h. 35m. on February 25th	1·00
„	In 3 days—March 1st, 2nd, 3rd	17·55

TABLE XI.—HYGROMETRIC RESULTS AT 9 A.M.

1880.	Dry Bulb.	Wet Bulb.	Dew-Point.	Tension of Vapour.	Relative Humidity. (Sat.=100)
	°	°	°	In.	o/o
January	81·4	77·6	75·0	0·868	81
February	81·1	77·4	74·9	·865	82
March	81·2	77·6	75·2	·874	82
April	78·6	75·7	73·7	·831	85
May	77·9	75·3	73·5	·825	86
June	76·9	73·6	71·3	·766	83
July	75·9	72·5	70·1	·736	82
August	77·3	72·6	69·3	·716	76
September	76·9	70·6	66·2	·644	70
October	79·3	75·0	72·0	·785	78
November	80·3	76·2	73·4	·823	80
December	81·1	77·3	74·7	·859	80
Mean—1880, at 9 a.m.	79·0	75·1	72·4	·799	80
Mean—1875 at 1 p.m. daily	85·4	77·0	71·5	·775	63

G. H. Simmonds's Tables have been used in the reductions.

The following are some remarkable readings (extremes) taken at irregular hours:—

	Date.	Dry Bulb.	Wet Bulb.	Dew-Point.	Vapour Tension.	Relative Humidity.
		°	°	°	Ins.	
1876	January 22, 4 p.m.	91·6	82·4	76·7	·918	62
1877	November 18, 2.30 p.m.	93·6	74·8	63·5	·586	37
1878	January 6, 2 p.m.	98·0	83·2	74·8	·856	47
1879	March 7, 3 p.m.	97·0	85·2	78·2	·965	55
1880	March 27, 1.30 p.m.	91·8	84·8	80·5	1·041	70
1880	September 21, 2 p.m.	92·6	74·3	63·1	·578	38

TABLE XII.—Clear Sunshine (estimated).

Month.	1878.		1879.		1880.	
	Total in each Month.	Daily Average.	Total in each Month.	Daily Average.	Total in each Month.	Daily Average.
	hours.	h. m.	hours.	h. m.	hours.	h. m.
January	228	7 21	153	4 56	182	5 52
February	226	8 5	154	5 31	200	6 54
March	193	6 14	244	7 52	219	7 4
April	187	6 13	204	6 48	166	5 32
May	217	7 0	239	7 43	198	6 23
June	231	7 42	231	7 42	191	6 21
July	235	7 35	263	8 30	196	6 19
August	248	8 0	289	9 19	174	5 37
September	291	9 42	215	7 10	231	7 42
October	225	7 15	227	7 19	195	6 17
November	256	8 33	220	7 20	225	7 30
December	272	8 46	211	6 48	180	5 48
Yearly Average per diem	..	7 42	..	7 15	..	6 27

Approximate Average for 3 years, unclouded sunshine 7h. 8m. per diem. Of days overcast throughout, no sun visible, there were—in 1878, 1 day; in 1879, 14 days; in 1880, 7 days; average 7·3 days.

Thunder heard.

Average No. of days per month, 5 years, 1876-1880.

January	10·8	July	2·0
February	10·0	August	1·2
March	11·4	September	1·6
April	8·2	October	5·2
May	5·4	November	9·0
June	1·8	December	8·2

Monthly Average, 5 years .. .. 6·2 days.

In this Table appears the average number of days on which thunder was heard here during the past five years, whether once or twice in the distance, or more frequently and near at hand. In the daily journal there are also entered the number of days on which lightning was seen; but this I have here omitted, as very liable to error from frequent unavoidable neglect to observe closely whether the thunder was or was not preceded by lightning visible at the station: it is merely a question of proximity, and while on dark nights the faintest flash is easily seen, in daylight lightning not many miles off may escape observation.

Silent or sheet lightning, so very common at night during certain seasons, has been also omitted for somewhat similar reasons.

Thunder heard, March 1880, on 17 days. From May 18, 1877, till November 26, none. From May 6, 1878, till November 12, twice only (once very distant).

Storms.—It is, fortunately, an easy task to record the storms that have occurred in Fiji, or, at least, in this part of it, during the past five years. In the former Paper I described the only true hurricane till then experienced

by me in Fiji, and which occurred on March 19th, 1871. Previously to that there stands on record one of great violence on March 10th to 12th, 1866; my informant being D. Wilkinson, Esq., Chief Commissioner for Native Affairs. And another in March 1856, vouched for by Ratu Esikaia, native Judge, a most intelligent and truthful man: the latter, now aged, states that previous to that year he can remember no great storm having occurred in Bua during his lifetime.

1876, January 10th.—A gale with heavy rain—5·73 ins. fell in 24 hours—but without thunder. Wind began, as usual, about SE, passing through E to N, and to W on following day, when it abated. No particular damage done, nor were any mercurial barometer observations made; the aneroid was unreliable.

March 16th.—A gale similar to the last: 16 ins. of rain precipitated between March 1st and 18th; much thunder was heard on nearly every day, but none on the 16th. The amount of damage done on shore, as usual with gales of the third or fourth order, was confined to knocking over such frail plants as bananas, maize, &c., and old or badly built huts.

1877.—March of this year was unusually hot and dry, and up to the 26th only 4 ins. of rain had fallen. On the 31st a gale occurred without rain, commencing in S, and in 24 hours passing through all the points of the compass, through E to N, &c. No damage done. Mean temperature in shade 81°·4, the highest average for March to date. Total rainfall was 7·22 ins., which may be compared with 25·04 ins., the average for March during the previous six years. The gale of the 31st prevailed generally over the group. A correspondent informed me that at Taviuni the wind blew continuously from the E; at times a lull followed by violent squalls took place.

1878.—No gales worthy of mention occurred here in this year.

1879.—February. 10th and 12th stormy with heavy rain; no sun visible for four days, except a few gleams on the 13th; an unprecedented circumstance here. Wind from NE to NW. No particular harm done.

Lowest reading of mercurial barometer 29·725 ins. at 3 a.m. on the 11th.

On December 11th a hard gale began from SE, and blew strongest from NE to N at nightfall. Light rain with the heaviest squalls: a little thunder and lightning early in the day only. Damage done was insignificant here. Lowest reading of barometer, at 8 p.m., 29·404 ins. Elsewhere in the group this gale was much more serious, particularly on the west coast of Vita Levu, where loss of life occurred, and a so-called tidal wave swept much of the low land bordering on the sea. Many vessels were cast ashore in various directions, the largest being the brig 'Shannon,' lost in Suva harbour.

1880.—No gales occurred here worthy of mention during this year.

Drought.—In contrast to our heaviest yearly rainfall, namely 159·51 ins. in 1871, may be now mentioned the opposite extreme, a severe drought that prevailed during the greater portion of 1877 and part of 1878. The following are the particulars of the amount of rain collected here during that period:—

	ins.		ins.
1877—May	0·83	1878—January	10·46
June	0·86	February	7·40
July	5·52 (!)	March	10·51
August	2·80	April	6·04
September	0·41	May	2·08
October	1·29	June	0·01
November	0·48	July	2·18
December	0·81	August	1·07
		September	0·17

Total 52·42 ins. in 17 months, or 260 hours, averaging 15 hours rainfall per month. The 12·50 ins. that fell in the above-named eight months of 1877 includes an unprecedentedly large amount for July, viz. 5·52 ins. as compared with 1·88 in. the mean fall for that month in the previous six years; showing still more clearly that meteorological affairs were completely out of gear. The number of hours of clear sunshine during 1878 are given elsewhere; the returns for 1877 are incomplete.

As regards local effects of the drought, they were very severely felt; and from the failure of the all-important yam crop, there was as near an approach to actual want of food among the natives as is well possible in a tropical country of such varied resources and luxuriance as Fiji. Wild roots in the "bush," vegetables and fruits, despised in general, but resorted to in times of scarcity, and the never-failing harvest of the sea, made amends for the shortcomings of the gardens. For us planters, in most parts of Fiji, the times were very bad; failure of young crops; the perennial plants, such as cotton, coffee, cocoanuts, sugar cane, &c. thrown back and partly destroyed. Very great injury was done by bush fires, which swept the open country in all directions, fed by the dry herbage and scrub, and fanned by the constant, strong, warm trade-winds. November and December are, in general, the months most favourable to vegetable growth, being in fact the spring season, with frequent rain showers and heavy dews, and winds diminishing in strength and veering frequently to the north. But those months in 1877 were, according to the best native reports, quite without parallel in their memory. The rainfall may be described as *nil*, so little effect had the few showers on the intensely hot dry surface of the soil. In December the wind blew from SE for 18 days, and between S or SE and N on the remaining 13 days, always blowing more or less from the SE quadrant. On 14 days the sun was unclouded throughout, on 10 days three quarters of each day were bright, and on the remaining 7 days one-half of each day was clear of clouds. The apparently large total fall of rain in 1877 was caused by the very heavy precipitation in January; and although the amount collected in 1878 was much less, namely, 56·87 ins., the latter year was much more favourable for agriculture, owing to the seasonable fall in the latter three months, October to December.

The intensity of the sun's rays in December 1877 culminated on the 23d, when the exposed black bulb thermometer on grass registered 172°·0; on the 24th, 162°·0; on Christmas day, 165°·7; on the 30th, 159°·1; on the 11th,

12th and 13th, 154°·8, 158°·0 and 164°·6, respectively. The mean temperature in the shade was 84°·1; highest 97°·6 on the 9th, which gave a mean temperature for the previous 24 hours of 88°·1. The hygrometer gave some remarkable readings, but it was not attended to regularly. For the first and only time in Fiji I noticed that the natives suffered much from sore feet, caused by travelling over paths made intensely hot by the sun. Their feet are generally as tough as cowhide, often enabling them to walk over fire, or on the top of live coral, an ordeal almost equally severe; but at this season foot bandages were in general use among them for protection, or at least among those travelling any distance along open tracks. This drought was felt generally over the group, but varying in degree; and not only in Fiji, but over a large extent of the southern hemisphere. In New Zealand it was so excessive as to cause almost a panic among the farmers in the South Island. In Australia it was likewise very severe; while many of the Polynesian Islands were threatened with, if they did not experience, quite a famine. Thus, I read in the *Australasian* of August 1878, a statement made by the mate of the 'Iserbrook,' then just returned from the New Hebrides, that "while off Tanna between 200 and 300 natives came off to the vessel in a starving condition, having been short of food owing to the severe drought. The captain and crew managed to get rid of all but 65, when a gale sprung up and obliged the ship to leave. The captain and three of the crew died subsequently; but whether of the disease that the natives suffered from or not, the mate is unable to say." If this drought forms the opposite extreme, as is most likely, to the great rains and storms of 1871, the crest and trough of the wave, then we may perhaps conclude the duration of a cycle here to be about twelve years.

Notes on the Months and Seasons.—On looking back and examining page by page of the daily journal, it is remarkable how few meteorological events have occurred worthy of special mention or description in ten long years. What would strike a stranger from England most forcibly is the rarity of destructive storms; compensated for, however, in a sanitary sense by the prevalence of the trade-winds, which blow so long with persistent, steady force, together with the entire absence of calms, at least by day. The high temperature at all seasons, always, however, falling short of 100° in the shade, would also be remarked, as would also the prevailing sunshine; the great amount of rain that falls in short spaces of time; and the large amount of aqueous vapour in the atmosphere. The latter, not unfrequently approaching or even exceeding a pressure equal to one inch of mercury, by remaining suspended in the air acts as a shield, without which life here would be insupportable, and by reason of which our hottest days fall far short of what so frequently obtains in higher latitudes—Sydney and Melbourne for instance. Finally, on closely observing the instruments, one is struck by the extreme, almost clock-like regularity, and the great extent of the daily variation of atmospheric pressure, as well as by the limited range of the hygrometer.

A few remarks on the months and seasons will, no doubt, assist any one to understand the leading features of the climate, when read together with the more solid facts contained in the Tables.

January, February and March constitute the true wet season; the average fall of rain for these three months, during ten years, was 60·45 ins., to which may perhaps be added December, mean fall 8·93 ins., and April, mean fall 9·06 ins. In January atmospheric pressure is at its lowest, and temperature in the shade at its highest. In those months also occur more frequently gales of wind and thunderstorms; but, as already explained, although destructive storms are exceedingly rare at all seasons in the colony, sudden squalls with tremendously heavy rain are not uncommon from December to March. February appears to be always calmer than January or March.

The sun is in our zenith on February 1st, and at the close of March, when the SE trades are again endeavouring to obtain the mastery over the then prevailing northerly winds, there is the greatest probability of a "big blow" or hurricane. During March most of the inter-island sailing vessels are, or ought to be, laid up in snug quarters, and persons who continue to sail their boats do so at a certain risk, and have to pay particular attention to their aneroids: but the heaviest gales are often preceded by calms, very variable light winds or squalls, so that the incautious navigator may, in spite of all precautions, be suddenly overtaken by a serious calamity. On land these are the busy months for planting, the soil in Fiji being generally light and porous enough to allow of field operations being carried on with little interruption from the heavy rainfalls that may then occur. In January there are occasional calms during the early parts of the forenoon, with a clear sky and an intensely hot sun, distressing for whites or blacks to work under. In houses, especially native built, *i.e.* thatched, it is indispensable to guard against damp and mildew—injuring books, pianos, &c. and the great pest of Fiji, mosquitos and flies, are at their worst. With the close of March passes away all thought of destructive gales for the season.

April and May are months intermediate between the true wet and dry seasons. They are pleasant months, the trade-wind blows freely, and the days are shorter, vegetation is every where luxuriant, and field work generally very active. Oranges ripen in these months, and the yam crop is matured; coffee-berries are turning red and fit for harvesting, and cotton boles begin to burst. Towards the end of June the ground begins to feel the effects of sun and wind and a much diminished rainfall. On June 21st, the shortest day, the sun rises at 6·30 a.m., and sets at 5·30 p.m., the difference between the longest and shortest days in the year being only two hours.

In July and August we look, and never in vain, for the full force of the SE trades; it is a cool season, but, strange as it may appear, it is, comparatively speaking, an unhealthy one, in so far as light chest affections, coughs and colds are concerned, especially among the natives. Evaporation is now excessive under the favouring conditions of clear sunshine and high winds. Many kinds of grasses die down, and the few deciduous plants are stripped of their foliage. The insect trouble is slight; the nights are cool, with little dew, and we keep a blanket beside the bed to occasionally draw over the single sheet found to afford sufficient protection during the greater part of the year.

September, October and November vary much in character, as may be seen by examining the tables of rainfall, temperature, &c. They are pleasant months; the boisterous trades having subsided, refreshing showers with thunder clear the air, and as soon as rain has penetrated sufficiently deep into the soil, nature, never dormant, but only slumbering for a short season, again wakes up and clothes the earth in richest verdure.

We hasten to put in the spring crops, especially such tender ones as maize and tobacco, which, if not planted until late in the season, may be injured by the rough weather of January to March. In the second week in November we again walk shadowless at noon, but yet we are able to work, and work hard, under the vertical sun, if only the breeze, which so seldom tires, blows freely past.

December, as already remarked, belongs by right to the "wet" season, though clear sky and steady breezes often prevail for many days in succession, with an occasional black lowering appearance near at hand or away to the north, the harbinger of coming events. Thunder and lightning are frequent on such occasions, winds variable but seldom falling quite calm except at night or early in the forenoon. An occasional hard squall with a little deluge of rain warns seafaring men to exercise due caution in navigating their vessels; and gardeners will see that tender or weak plants are protected with stakes. The year closes after Christmas with a condition of elements prevailing that differs widely, on the one hand, from the frost, snow and biting cold of England, and on the other, from the scorching droughts and bare pasture of many parts of Australia.

Exceptional Phenomena.—Hail.—The island of Cicia (Thithia) lies in the windward or SE part of the Fiji group, in latitude 17° 45′ S, longitude 179° 20′ W, and that district was visited by a hailstorm on April 29th, 1878. Such an occurrence appears to be previously unknown to the natives, who were quite ignorant of the nature of ice or snow in any form.

The oldest Fijians, so far as I can ascertain on inquiry, know nothing about hailstones, never having seen them fall, in this district at least, or in any other part of the group, before some of them were enlightened on the occasion about to be described: so that this occurrence in the Lau district, apparently without precedent during the lifetime of the present generation, naturally created quite a sensation among those who witnessed it.

Mr. George McEvoy, the proprietor of the island of Cicia, kindly sent me the following particulars of the occurrence:—"The hail and rain storm alluded to occurred on April 29th (1878), at 11.30 a.m. We had a beautiful morning, cloudless sky, till about 10.30 a.m. My schooner, the 'Dauntless,' had just arrived from New Hebrides, and the hailstorm lasted from 20 minutes to half an hour. The anchorage faces west, and the hail fell both on shore and on board the schooner. No hail fell on my plantation, facing SE, distant from the anchorage about six miles. No hail is reported to have fallen on the adjacent island of Mango; but WNW from here, at a distance of 18 to 20 miles, hailstones fell also. The hail soon disappeared, say five minutes after falling: no damage done. Rain, the heaviest I have experi-

enced in eight years, followed for about two hours. I may mention that 1877 and the present have been very dry years. One amusing incident, *re* the hail, occurred: an imported Polynesian labour-woman was intensely surprised; she collected two saucersfull, and took them into the house, saying she would keep them to show her countrymen on her return home some eighteen months hence; half an hour afterwards she went to look at her marvellous prize,—tableau!"

The above letter had been copied out, when a few days ago I received another most interesting account of a fall of hail or *ice*, and my informant was, fortunately again, far beyond the slightest suspicion that might possibly be attached to a lesser authority recounting such a very remarkable occurrence. The Rev. Fredk. Langham, Wesleyan minister for many years in Fiji, wrote me as follows:—"I have looked up the event referred to in my journal: the extract is as follows:—'On Tuesday, May 15th, 1866, returned home (from Levuka to Bua). When within a mile of Bua the wind, which had been fair, suddenly shifted to the south, and blew extremely cold. After being on shore about an hour we were astonished by a fall of ice. It showered down for about a quarter of an hour, or perhaps less, irregular pieces of all sizes and shapes. I picked up one piece in the shape of a cross, 1¼ inches long and ¼ an inch thick. The natives were amazed, never having seen any thing of the kind before. Some were afraid to eat it, lest they should be poisoned! The shower was not seen at Ovalau, though it extended in an easterly direction to a greater distance, beating down the sail of a large canoe which was sailing from Gau to Batiki.' You will see that it was *ice*, and not hail, that fell. One of my servants was stooping down to turn the tap of the tank, when a piece struck him in the back and he said he thought a *bullet* had struck him. When I say the pieces were of all sizes, I do not mean that they were any larger than the size I have named. I saw none larger. I did not learn where it was first noticed in the south, nor how far it extended north-east, the direction it took to meet with the canoe. This is the only instance that has come under my observation during my 22½ years' residence in Fiji."

There remains one more instance to record of a hailstorm in Fiji, and it occurred so recently, or rather the newspaper account has only just reached me, that there is no time to write to the spot for fuller particulars. The island of Rambi lies close to the eastern extremity of this large island, Vanua Levu, and is the property of Captain T. Hill and Co. The *Fiji Times* of December 18th, 1880, is answerable for the following:—"A terrific thunderstorm passed over the island of Rambi on the 20th ult. (November) about noon. For a day or two previously the weather had been sultry, and on the morning of the day in question heavy inky clouds gathered to the southward. About noon a violent commotion was observed in these clouds, a number of whirlwinds came up, and three waterspouts were seen, some three miles from the shore, at the same moment. Presently the lightning became fearfully intense and frequent, the thunder pealing in incessant crashes, accompanied with rain. When the storm was at its height a tremendous fall of hail-

stones took place, lasting fully twenty minutes. These stones were exactly the size and had the same appearance as the confectionery called 'acid drops.' Many vessels full of this ice were gathered, and '*ices*' became the order of the day. The labourers on the estate were astounded at such a sight as stones falling."

Lightning—fatal accident from.—At the township of Bua, in the native school, presided over at the time by the Wesleyan missionary, the Rev. T. Leggoe, there occurred on May 23rd, 1876, during a severe thunderstorm, the only fatal accident from lightning that has come to my knowledge in Fiji. A little native boy sitting at the foot of the centre post, that extends up to the ridge, was struck dead by a flash that had entered at the roof, and followed down the tall post. A small hole was rent in the thatch, which was set on fire but easily extinguished in the heavy rain. The missionary's own children standing near had a narrow escape, one of them being for a time benumbed.

Sunstroke.—No cases of sunstroke have come under my notice, fatal or otherwise, for several years past: not since the occurrence already recorded in my previous report.

Fog.—Nothing new to add to the previous remarks on this subject. I have seen no fog worthy the name in Fiji: but in some of the larger river valleys, in the calm, early mornings, fog or floating mist is occasionally met with: where there is a large body of super-heated water, with great evaporation, and above it a stratum of cold air flowing down by gravitation from the adjoining hills.

Earthquakes.—Notice of these is often found in meteorological reports, but why it is not easy to explain; unless it be that if not therein recorded, their occurrence, if slight, would in many districts probably pass into oblivion. To the two light shocks mentioned previously, as being the only ones felt here in six years ending with 1875, I have now to add three others experienced here during five more years, to the close of 1880:—

1. On April 12th, 1876, at 4 p.m., a smart shock was felt here. On the same day at noon, corresponding to 12.24 p.m. of our local time, there occurred at Oamaru in New Zealand, and generally throughout the island, one of the severest shocks felt there in late years.

2. On June 4th, 1876, at 7.30 p.m., a light shock.

3. On May 9th, 1879, at 7 a.m., a very smart shock that lasted for several seconds, and caused many things, pictures hung on the walls, &c., to vibrate.

Sea-water Temperature.—The highest temperature of sea-water observed by me was 88°·8 on January 23rd, 1876: in an estuary at low tide and five feet below the surface of the water. The mean temperature in shade of the week previous was 80°·7, bright sunny weather prevailing. But on December 24th, 1877, during the long drought, the temperature of a tidal creek, our usual bathing place, rose to 95°·0; and five feet below the surface it was 97°·0 (!), or nearly blood heat. In the first instance the water was just brackish, in the latter it was salt, almost pure sea-water. The usual

temperature of this creek, which flows out of a swamp two miles distant, is from 75° to 88°, according to the season, rainfall, clear nights, and absence or otherwise of sea-water influenced by floods.

Sanitary.—To my former remarks on this subject there is little to add. So far as I am aware, there have been no vital statistics published by the Registrar-General showing the percentage of deaths among the white settlers in Fiji, or the nature of prevalent diseases. As regards the native population, a document issued from the 'Provincial' office, Levuka, shows that at the close of 1879, the census returns gave the number of natives in the group as 108,924, of which 51,481 were females; and that the net increase of births over deaths for that year was 307.

In the Report of the Commissioners—Commodore Goodenough and Mr. Layard—concerning the cession of Fiji, there is a paper containing some observations by Dr. Messer on the health of the islands. That authority states that the Fijian archipelago is "singularly free not only from tropical diseases, but also from most of those diseases which, in England and other countries, yearly cause a large amount of sickness." Fiji, unlike most or all the groups in the Pacific to westward, including the New Hebrides, so near and yet so unhealthy, is indeed "singularly free" from tropical or other diseases. Of fever and ague, the scourge of Western Polynesia and so many other places, not one instance has as yet originated in Fiji; and further, I recently met a Scotchman, who having while working on the Panama railway contracted very severe illness from this cause, has had no return of it since he came to this group. All or nearly all of the islands in the South Pacific to the *east* of Fiji claim the same immunity from this tropical disease. Why this should be so it seems difficult to determine,—whether it is the extra distance from the main lands of Asia, Australia, and New Guinea, or the heavy rainfall and its hygienic results, or the hygrometric condition of the air, or the more steady flow of the SE trade wind, the prevalence of sunshine, the geological formation, or a combination of these and others. Until recently, when they have been prevented so doing, the natives used constantly to build their villages in swamps and salt-marshes, that in most other parts of the world would be a very hotbed of fever and malaria. As climate is the all-important factor in considering the question of selecting a suitable settlement or place of abode, it may be quoted against Fiji that her European population has not only not increased during several years past, but that it has actually receded from about 5,000 in 1873-74 to a handful of little more than 2,000 at the present time. But this retrogression in numbers was brought about, not from fear of the climate, but as a natural consequence on the collapse of cotton growing, through the ruinous fall in prices of that staple in the English market.

There are many Europeans now in Fiji, who have resided here for 15, 20 or more years, in the enjoyment of excellent health, and it is a constant remark how well the country and climate agrees with children; but with women it appears somewhat different. Loss of nervous energy is common to all, and this is more marked in the case of women, especially those who

are nursing children. Heat and moisture, indoor occupations, a craving for more society than is afforded by the few white residents scattered far apart, and a general want of excitement for the mind, all help to this, and sooner or later compels those thus enervated and depressed to seek a change in a cooler climate. We whites, with our thick blood and highly strung organisation, cannot make permanent homes within the tropics, any more than black races can prosper and increase in cold countries. But as a new colony in which England can safely push forward her indefatigable pioneers, with a good prospect of worldly success and little injury to health, Fiji holds out greater inducements to settlers who have naturally sound constitutions than probably any other of her tropical possessions.

Foretelling Weather.—There are doubtless in all places certain local signs or effects which the inquiring resident soon learns to interpret, besides others of more general application. Here in Fiji, where the sea is our chief highway, and where, to reach the seat of Government—Levuka at present, but soon to be Suva—it is at all times necessary to cross more or less of the ocean, often in small open boats, it behoves all to become as weather-wise as possible. All mariners carry, or ought to carry, a good aneroid or marine barometer, and to strangers in the group it is as well to point out the great extent and extreme regularity of the diurnal range of atmospheric pressure: thus the 8 p.m. readings average ·070 in. below those at 9 a.m., temperature being alike; and the mean pressure in January is about ·170 in. below that in August, when heavy southerly winds prevail. The barometer appears to be little influenced by the approach of rain *only*, without high wind, unless a very heavy fall is at hand; and in foretelling rain the hygrometer is a much more reliable instrument; thus a difference of 8° to 10° indicates fine dry weather, while if the readings approach within say 8° after the sun is well up, rain may be looked for, particularly if the wet bulb exceeds 75°, a common occurrence. When it approaches 80° about noon, with the air not over 85°, rain may be confidently expected before many hours. In the wet season—January to March—very often for days together the wet bulb will exceed 80°, with perhaps 8° to 5° of dryness.

Noon is here the most critical period of the day, sunrise to 10 a.m. the finest. As elsewhere a *backing* wind is indicative of rain or storm; also very variable light breezes. One of the longest spells of very wet weather was preceded by three days during which the wind passed four times round the compass. Sharply defined cumulus clouds are a sign of rain; also great clearness or visibility of the atmosphere; three or more cross-currents of wind above, as shown by clouds; the inland flight of seabirds, and unusual activity of insects such as flies and mosquitoes. But in settled SE dry weather opposite signs may be seen, such as *very high*, almost stationary cirro-cumulus clouds ('mackerel sky'); low, very swift scud before a high SE wind; on nearly calm days small whirlwinds rushing past; a few drops of rain from a passing cloud; a haze rendering distant objects indistinct, and great relative dryness of the atmosphere. A strictly local sign of really bad weather has been long noticed by us as infallible; thus, there is a coral

reef about ten miles off shore to the northward, too far away for us ever to hear the surf breaking on it, but in still nights before bad weather sets in, a booming sound, low but distinct and continuous, is borne to us, not from the direction of the reef, but almost at right angles to it, from a large grove of tall cocoanut trees half a mile distant. Lightning is seldom seen or thunder heard during the dry season: when we are anxious for rain we are glad to hear thunder, as it is a sure sign of a change. During the wet season, particularly at the beginning of it, there is very much thunder, but in the height of a great gale or cyclone none is heard. Electric discharges perform the overture, and then retire till the wind has spent its fury.

Miscellaneous.—It has happened on several occasions when a long period of dry weather has occurred here, with constant strong SE winds, that similar conditions obtain simultaneously in parts of New Zealand; only there the NW winds, or return-trades, prevail. Two most marked instances of this are the following: Near the close of 1877, during the long drought, when SE winds here were continuous and violent, the complaints against the weather in Canterbury, New Zealand, were at least equally great; and in the *Canterbury Times*, of December 1st of that year I read as follows: "The wind has been blowing from the NW for the last eight weeks, it has now changed to SW." On the Canterbury plains the drought was, in consequence, very severely felt, the NW wind being there very dry and parching; and the crops were much injured thereby.

Again, in August 1880, from the 9th to the 22nd we had here constant boisterous SE winds, almost a gale at times, weather otherwise dry and clear. Afterwards I noticed in the local journals an account of a NW gale in Canterbury, New Zealand, on the 20th of that month, that for violence had been unparalleled for years. Christchurch lies about 1,600 miles south of this, in atitude 43° 32′ S.

It is worthy of notice that while Fiji, together with a great part of the southern hemisphere, suffered so severely from drought during parts of the years 1877-78, such a striking difference of climate prevailed in the far north. England, especially, seems to have been deluged with unseasonable rains, and to have suffered from bitter cold, fogs and want of sunshine during the winter and other months of those years. The President, Mr. Greaves, in his annual address to this Society in January 1880, urged the Fellows to particularly study the movement of the atmosphere in its hygrometric relations, and endeavour to answer such questions as, "Where does the moisture which is found over Western Europe come from? Does it all come from the Atlantic, or beyond the Atlantic?"

It is with much diffidence and consciousness of many shortcomings that I venture to lay these remarks and statistics before the Fellows of the Meteorological Society. Having no intercourse with the outer world except through a very irregular post, and plantation work, &c. ever claiming close attention and labour, it was not easy to devote sufficient time to meteorology, so exacting in its demands at particular hours each day. However, encouraged by the reception accorded to my former report, and of the more recent

publications by Mr. R. H. Scott, entitled "Contributions to the Meteorology of the Pacific,"* I now venture to supplement those by this my contribution from the sunny and beautiful, but far-distant, Islands of the Sea.

APPENDIX.

The following tables of meteorological statistics were kindly supplied to me by the gentlemen whose names are attached. They are all the returns from Fiji that I am able to collect. There are no Government meteorological stations, not so much as one rain-gauge in use even, so far as I can ascertain.†

Considering that this is a new colony, and that agriculture must always form its main source of prosperity and wealth; that the climate varies so much in different parts of the group; and that the principal crops, such as sugar-cane, coffee, cotton, cocoanuts, cinchona, &c. require special care of the planter in selecting suitable sites, not forgetting the imperative demands of science—it is astonishing that so little has been done in aid of meteorology.

Fiji has been a British colony for nearly 5½ years, under Governor Sir A. H. Gordon. While the detachment of the Royal Engineers were in Levuka, Colonel Pratt, commanding officer, and after him, Lieutenant Lake, took meteorological observations with good instruments: the thread was snapped on the withdrawal of the Engineers, and so much valuable labour was in consequence almost thrown away. Compare this apathy with the splendid results achieved in other Crown Colonies, Mauritius and Ceylon for instance.

Mr. J. Newall's Table of Rainfall.—Qara Walu, where Mr. Newall resided in 1876-77, is near the southern extremity of the island of Taviuni, which is the third largest in the group, 24 miles long by about 9 broad. The house lies 564 feet above sea level, and 2¼ miles from the coast, on the slope of the long range of high hills that run nearly the entire length of the island, and exposed to the SE trades, as vapour laden they first strike the high land and deposit the trifle of moisture as shown in the Table. In 1878 Mr. Newall took up his abode near the sea in the same district, and close to the flourishing township of Vuna. The returns for 1879-80 show a marked difference from those taken at the higher station.

Mr. Hy. T. Shave, manager for Mr. W. F. Parr, obliges me with some notes of observations taken at Wai-manu, a branch of the Rewa river, SE of Vita-Levu, the largest island in the group. The Rewa agricultural district is the most important in Fiji; it has a large and rapidly increasing European population, with several sugar mills in full work. Mr. Shave has unfortunately

* To one of these is attached a small map of Fiji. See '*Quarterly Journal of the Meteorological Society*,' Vol. III. p. 384.

† Particulars as to the Instruments supplied in 1860 by the Meteorological Department to Colonel (now General) W. J. Smythe, R.A., for use in Fiji, with results of the observations taken with them, will be found in the '*Quarterly Journal*,' Vol. III. p. 384.—[ED.]

forgotten to send me particulars of the quality and position of the instruments used, and it is now too late to remedy the oversight. Forests and high hills abound near the Rewa; in consequence, we see in the Table a large number of days on which rain fell, and, compared with this station, a much lower mean temperature in shade.

I presume, but cannot say for certain, that the solar thermometer is insulated *in vacuo*.

RAINFALL AT VUNA, TAVIUNI, FIJI. MR. JAMES NEWALL, Observer.

Months.	At 'Qara Walu,' 564 feet above sea level, 2½ miles from sea coast.				At 'Wai ni Geri,' 30 feet above sea level, 100 yards from sea coast.			
	1876.		1877.		1879.		1880.	
	Ins.	Days.	Ins.	Days.	Ins.	Days.	Ins.	Days.
January	17·73	21	27·23	24	3·09	..	14·76	16
February	17·52	17	17·93	21	20·53	..	4·03	17
March	19·10	23	54·30	21	7·51	16	12·20	9
April	23·67	20	38·86	22	10·75	12	17·34	23
May	16·34	20	5·38	11	6·84	8	7·17	13
June	24·25	23	23·90	18	16·14	14	10·45	12
July	6·90	13	18·58	26	4·05	11	12·24	15
August	31·52	27	34·25	22	6·24	13	25·46	20
September	27·37	17	1·95	13	5·53	13	9·56	14
October	20·35	20	18·24	18	6·04	15	21·37	12
November	11·59	12	2·69	17	7·07	9	12·37	20
December	26·73	23	8·26	15	7·25	17	17·23	25
Total	243·07	236	251·57	228	101·04	..	164·18	196

Greatest Rainfall in 24 hours:—

In 1876	8·48 inches
„ 1877	11·82 „
„ 1879	5·17 „
„ 1880	7·23 „

RESULTS OF METEOROLOGICAL OBSERVATIONS TAKEN AT WAIMANU, REWA RIVER, FIJI, by MR. HENRY T. SHAVE.

(Height above Sea Level, 150 feet.)

	1878.	1879.	1880.
	°	°	°
Mean Temperature in Shade	75·6	75·8	74·5
Absolute Maximum „	99·0	92·0	98·0
Absolute Minimum „	56·0	61·0	53·0
In Sun's Rays—Mean of all Maxima.....	..	..	138·7
Absolute Maximum	..	..	163·0
On Grass—Mean of all Minima	..	..	62·6
Absolute Minimum.....	..	..	51·0
Rainfall in inches	103·82	116·04	137·87
Greatest Fall in one day	5·62	4·70	11·00
Number of days rain fell on.....	206	240	230
Mean Velocity of Wind, in miles per day	..	..	97 1
Greatest Velocity in 24 hours	..	..	295·8

DISCUSSION.

Mr. J. CURTIS said that he had made a comparison of the results of observations made by Mr. Vaughan, one of the Government officials at Levuka, and those of Mr. Holmes at Bua. He found that there was a great difference between the maximum and minimum temperatures, the maximum at Levuka always reading lower, and the minimum higher, than at Bua. This, he thought, was not due to climatic change, but to the bad exposure of the instruments at Levuka. The barometric pressures appeared to agree very well, but the rainfall showed a difference, inasmuch as at Levuka, in each of the two years examined (1879 and 1880), the totals for April and October were very decidedly higher than those for March and October respectively, while at Bua the reverse was the fact.

Mr. MAWLEY congratulated the Society on having, in a position so important as Fiji, such an excellent observer as Mr. Holmes. He thought the striking differences in temperature mentioned by Mr. Curtis would be found to be mainly owing to some difference in the exposure of the thermometers at the two places. Mr. Holmes's plan of placing his instruments, he considered a good one to adopt in so hot a climate, as the evergreen foliage covering the roof of the verandah would be likely to afford, not only to the screen itself but also to the ground beneath it, efficient protection from the direct rays of the sun during the hottest part of the day. Considering the situation of these islands within the Tropics, their climate must, to judge from the author's description, be a healthy one for Europeans, and would no doubt be still more so were they always in the current of the south east trades, instead of coming from time to time under the influence of north-westerly and other moist winds. When passing through the south-east trades in the Atlantic, he (Mr. Mawley) had on several occasions noticed how dry for the sea the air was, more particularly near the southern borders of this region, and he thought that if these winds were equally as dry in the Pacific, the remarkably low humidities recorded on several occasions by Mr. Holmes might in this way be to some extent accounted for. Be this, however, as it may, these instances of extreme dryness still remained most extraordinary, the island on which the author's station is situated being only 25 miles across, at right angles to the path of the prevailing wind, and far distant from any continent.

Mr. LECKY said he had recently read a very interesting book entitled 'Coral Lands,' by Mr. Stonehewer Cooper, the first volume of which contains a very good account of Fiji, and describes some "blows" which have done great damage. Though there was very little of a meteorological character in the book, still it was well worth reading.

Mr. BEAUFORT thought that Mr. Holmes's maximum readings were not reliable, as the roof, a corrugated iron one, was protected from the sun by vegetation only; and many years' experience in India had taught him (Mr. Beaufort) that that was quite insufficient. He mentioned that in India, although the tents had nine folds of thick cloth in two roofs, the sun was so powerful in the hot weather that one had to get under the table for protection. Mr. Curtis's statement that Mr. Vaughan had found the readings too high confirmed this view.

Mr. ARCHIBALD said he thought Fiji one of the most suitable places in which to record meteorological observations. From its position in the SE trade wind district, and away from the disturbing effects of continents, it might be used to test the variation in the intensity of solar radiation through the medium of the velocity of the trades, which should vary directly with the solar heat. From the paper it appeared, that while in 1871 there was an unusually heavy rainfall, and in 1877 a great drought (conditions similar to those which prevailed throughout the Indo-Malayan region in both years), the wind in the latter year was much stronger than it was in the former. This looked as though the rainfall varied inversely with the velocity of the prevailing winds. When these were weak, the vapour was more easily precipitated; when, on the other hand, as in 1877, they were abnormally strong, the vapour was carried over the island too fast to allow of its precipitation.

Mr. C. HARDING stated that Fiji was not in the SE Trade-wind throughout the year, but was situated between the NE and SE trades in January, February and March, the trades being then at their most southern limits. He considered it satisfactory that Mr. Holmes had ascertained that his aneroid was 0·4 inch too

high, since after that correction had been applied the published observations would agree well with others for the same place.

Mr. LAUGHTON said it was a misconception to suppose that the Fiji Islands are in the heart of the south-east trade. Theoretically, and from their latitude, perhaps they ought to be: but the South Pacific Ocean has not frankly accepted Hadley's theory; and its winds, more especially during the summer months, behave in a systematically irregular manner. At this season the trade-wind proper is limited to the eastern part of the basin; and curling round on itself gives, towards mid-ocean, a district of north-easterly winds, similar possibly to the north-easterly wind on the coast of Brazil, but certainly having no connection with the north-east trade, which does not cross the line, and as little with the doldrums of the equator. The central area of high pressure, every where associated with the system of trade-winds, lies, in the South Pacific, very far to the east, relatively close to the coast of South America; and the anti-cyclone does not, as in the Atlantic, extend over the whole ocean. These north-easterly winds gradually, as the longitude becomes more westerly, take a northerly and north-westerly direction, and so merge into the north-west monsoon, which at this season reaches nearly half way across the Pacific; south of which, in the far west, is a small district of irregular south-east wind, as though the trade was endeavouring to assert its theoretical rights. But, taken as a whole, the winds of the South Pacific are very far from being that exact illustration of Hadley's theory which, in the old text-books of physical geography, they were said to be. The Fiji Islands lie towards the western part of the region of north-easterly winds just referred to, and have thus probably seasons of north-east, of north-west, and of south-east wind. Observations of these, tending to define their limit, are therefore likely to prove extremely interesting; more so, even, than if they were made strictly in the heart of the trade.

Mr. SCOTT said that he had recently been studying the Admiralty Wind and Current Charts, and these showed that in the South Pacific the south-east trade was not continuous across the ocean except from July to September, but was broken by a belt of non-trade-winds, about 12° wide and stretching NW and SE with the Society Isles at its centre, roughly speaking. The Fiji group were situated in the western and smaller of the two portions into which the SE trade is divided, and only in the first three months of the year is Fiji shown just outside the trade-wind area, between it and the NW monsoon of New Guinea; but it cannot be said to be in the Pacific doldrums, for a steady ENE wind is shown on the chart during these three months.

The PRESIDENT (Mr. Symons) regretted that Mr. Holmes had not used a *thermomètre fronde* in addition to the other instruments. He considered that neglect of the wet-bulb thermometer would never give the humidity *too low*. The thermometers were, in his opinion, tolerably well protected, considering that there was a thick matting of vegetation on top of the corrugated iron roof, and that the instruments were placed in a Stevenson's screen.

PROCEEDINGS AT THE MEETINGS OF THE SOCIETY.

MAY 18th, 1881.

Ordinary Meeting.

GEORGE JAMES SYMONS, F.R.S., President, in the Chair.

DAVID WILSON BARKER, Mayfield House, Worcester;
BENJAMIN JUMEAUX, L.R.C.P., M.R.C.S., Rochford House, Swanage;
WILLIAM OELRICHS, Fernleigh, Oxton, Birkenhead;
HENRY PORTER, F.R.G.S., 181 Strand, W.C.;
WILLIAM ROPER, Southfield, Lancaster; and
Rev. G. ROBERT WYNNE, M.A., Woodlawn, Killarney,
were balloted for and duly elected Fellows of the Society.

The following Papers were read:—

COMPARISON OF ROBINSON'S AND OSLER'S ANEMOMETERS, WITH REMARKS ON ANEMOMETRY IN GENERAL. By RICHARD H. CURTIS, F.M.S. (p. 205).

NOTES ON WATERSPOUTS OBSERVED AT CANNES, ALPES MARITIMES, FRANCE, IN JANUARY OR FEBRUARY, 1872. By the HON. F. A. ROLLO RUSSELL, M.A., F.M.S.

THE phenomena about to be described occurred about the end of January or in February 1872, and were noted down by me at the time, but I omitted to insert the date and have no means of recovering it; as, however, they were seen by many persons, and were the subject of remark among the English residents, it is possible that the omission may yet be supplied. At 7.25 a.m. I saw in the south-east a small cone hanging with its apex downwards from the edge of a cloud-mass which occupied the whole sky down to the horizon except in that quarter, where brilliantly fine weather prevailed beyond the above-mentioned edge of the cloudy mass. The cone was projected against the white sky, and luridly illuminated by the rising sun. The cloud seemed to consist of nimbus and cumulo-stratus, the latter forming the boundary from which the cone proceeded. Rain fell at the point of observation, the Villa St. Anne, on the east side of the town, and thunder and lightning occurred at intervals of a few minutes. The clouds were high, and resembled those which produce a sharp thunder-shower in England in spring or autumn.

The movement of the cloud-mass was rather rapid from about NE, and about parallel to its edge, so that the apparent distance between the boundary and the sea line or horizon remained constant. The north-eastern portion of the cloud was unfortunately hidden by rising ground, and all the phenomena visible in the cloud must have taken place over the sea, as the coast bends northwards for some miles, forming the bay in which Nice is situated. At a rough guess the distance of the cloud's margin in the SE from the point of observation may have been from four to six miles. The apex of the above-mentioned small cone gradually became larger, the cone increased in size and especially in length, and its outlines became so clearly defined, that the changes in its form were seen with the greatest distinctness against the bright sky. Suddenly, a long black line connected the cone with the sea. That portion of the sea above which the cone advanced had up to this time been hidden by the hill in the foreground, but now, with the movement of the cloud, the whole field of operation of the spout was brought into view. Exactly beneath the cone, a greatly agitated white spot, resembling seething foam, and corresponding in size to the base of the cone, kept pace with the cloud as it moved rapidly westward. A spray or mist seemed to rise and spread itself out all round the trunk which connected sea and clouds. Enveloping the lower half of the stem of the spout, this mist was at first shaped like a common water-bottle, but gradually assumed the form of an egg. Suddenly the stem seemed to break off in the middle, and the cone and white circle of foam then rapidly drew in and disappeared. Towards the end of the phenomenon, the lower half was illuminated by the sun. The duration of this waterspout was about 12 minutes. There was thunder and lightning every few minutes before and after its appearance, but none while it lasted.

After the exhaustion of this spout, eight or nine others followed in rapid succession, differing little in their characteristics from that above described. In one case the cone was small and tapered very sharply off, and the long stem in crossing a sunny space shone like a stream of silver, then turned black again on entering the shade. In another the upper cone hung for a long time, and gradually prolonged itself downwards without any apparent effect on the sea beneath. At length, however, a black smoke rushed up from below, a fine thread joined the apex of the cone, and for a short time the waterspout was perfect. The most remarkable of them all was one in which the top outstripped the lower portion of the spout so that the stem lengthened and made an angle nearly half way between sea and cloud. In this case the cloud seemed to float at a great height. The distance between the ends continued to increase until the stem, as if overstrained, broke at the angle, and the phenomenon vanished.

A yacht arrived at the port the same day, and it was learnt that she had passed many waterspouts the previous evening.

The condition of the atmosphere in which these waterspouts were developed

must have been largely dependent on the geographical peculiarities of the neighbourhood. On looking at a map of the district we see that the NE wind passing a little to the SE of Antibes would have crossed the least distant portion of the great chain of the Maritime Alps, where the highest peaks rise to an altitude of 10,230 feet. They are distant about 30 miles from the bay of Nice, where the waterspouts occurred, and as the range stretches in a north-easterly direction, the wind from that quarter would have become greatly reduced in temperature. The air lying over the Riviera and Mediterranean was doubtless much warmer and damper, and protected from the full influence of the north-easterly wind by the high hills which make that coast remarkable for its genial climate. There would consequently be an abnormal tendency of the lower air to ascend, and of the upper stratum to take its place. The height of the clouds from which the waterspouts fell was estimated at about 2,000 feet.

Recent consideration has led me to place them among those instances which support the hypothesis that waterspouts are due to electrical as well as other atmospheric agencies, and consequently to hope that the subject may gain something theoretically by discussion.

Bearing in mind the facts above detailed, it would seem that the production of a waterspout may be due first to the rapid passage of a mass of cold air over a lighter stratum, and secondly to the slow discharge of electricity between the clouds and the sea. A liquid or gas in rapid movement over a lighter fluid of the same kind moving more slowly, does not descend as it would do if at rest; and cold, heavy air passing quickly over warm, damp and lighter air, would certainly not take the place of the lower air by means of thin, unbroken filaments or columns like those which appear in water when the upper stratum is much colder than the lower. We have then a condition in which relative rest would immediately determine an exchange of situations. Descent by squalls would occur in ordinary circumstances. The particular atmospheric condition may, however, be too local to admit of their ready production. Now if the surfaces of the cloud and of the sea are in opposite electrical states, the strong attraction between them will not be prevented by the rapid movement of the upper stratum from causing them to approach, and at a certain point the resistance of the air will be overcome and the cloud will descend in the form of a cone with the apex downwards towards the sea, while vapour and water will be carried upwards from the sea towards the cloud, till a column of thick vapour and water particles extends between cloud and sea, forming a medium of slow discharge for the electricity of cloud and sea. Some such appearance, *minus* the visible vapour, would be produced by strongly electrified tow or cotton-wool held over a bowl of water. The process on the scale of nature could hardly fail to be accompanied by a whirling motion such as has been so frequently observed in waterspouts, for the ascent or descent of air through a small column resembles the escape of water through a small hole, which causes eddies.

The rapidity of the general movement thus hinders the quiet interchange of air between two strata, and the presence of a high electrical tension favours the interchange of electrically charged particles. Again, the unstable equilibrium of the strata favours a slow discharge by means of an actual transference of vaporous particles rather than by an ordinary flash of lightning. If there were little electric difference the transposition of air and vapour might take place by squalls, and if besides there were little movement or no great differences in weight and temperature, then by ordinary gradual interchange; and if the electric tension were high, but the other conditions normal, the electric discharges would take place by flashes of lightning. But the rather rare combination of conditions above specified may tend to relieve the strained relations both of atmospheric weight and of electricity by means of waterspouts. The strange movements of tropical dust-whirls and waterspouts, the strong electrification of objects during their passage, and the attenuated but formidable columnar form in which they frequently appear, indicate electricity as largely contributing to the production of these phenomena.

Mr. LAUGHTON said that in a recent memoir Mr. Ferrel attributes the origin of waterspouts to a rapid rotatory motion, beginning in the upper regions of the air, and extending downwards. Within the area of this rotation, which he describes as exceedingly small, the air is rarefied to an extreme degree; he

speaks of a comparative vacuum of from 4 to 5 inches. The apparent ebullition at the surface of the sea is due to this vacuum, and the spray and vapour carried up in it form the body of the waterspout, becoming suddenly visible or vanishing from sight, according as the temperature, affected by this great rarefaction, passes on one side or the other of the temperature of condensation. Any work of Mr. Ferrel's is worthy of serious consideration; but it is difficult to conceive this extreme rarefaction as confined within such very narrow limits. The conception is not supported by observation. No barometric disturbance has ever been noticed as a concomitant of waterspouts, even though the observer was dangerously close to them. Mr. Ferrel speaks of a ship that got actually into one off Cape Sable. Forward, she was reduced to a wreck; aft, she was uninjured, and the barometer was unaffected. He felt a difficulty in believing that, if such an extreme rarefaction of the air as Mr. Ferrel spoke of really existed, it could not be observed, in however modified a form, at the distance of a few feet. The bent and twisted shape which waterspouts frequently assume presented another difficulty which stood in the way of his frankly accepting Mr. Ferrel's deductions. Mr. Russell's diagram on the wall showed one such form, which, he believed, was not uncommon. But he could not understand how a line of extreme rarefaction and rapid rotation could be bent in such a manner. He would rather accept Mr. Russell's view that such phenomena are electric in their origin, even though he was unable to explain the exact way in which electricity acts. This too, he might add, was the opinion that Mr. Baddeley, after prolonged observation, had arrived at, as to the origin of the dust storms of India—phenomena which were, presumably, of the same nature as waterspouts.

Mr. LECKY attributed the formation of waterspouts to electrical action. It was well known that places which had been struck by lightning showed that in the interchange of the powers as much electricity went upwards as came downwards, he therefore thought the same thing obtained in waterspouts; the earth attracting the clouds downwards, and the clouds in the opposite direction attracting the sea in the form of spray.

ON SOME SWEDISH METEOROLOGICAL OBSERVATIONS IN CONNECTION WITH THE RETURN OF THE SEASONS. By ALEXANDER BEAZELEY, M.INST.C.E.

THE subject of an observation and record of thunderstorms having been brought before the Meteorological Society by Mr. Scott in March 1872, and observations on various phenomena of the vegetable and animal kingdoms having been carried on under the auspices of the Society since 1875, it is probable that a brief notice of what is being done in the same direction in Sweden may be of interest.

There are in that country about 500 observers in connection with the Meteorological Department of the Royal Observatory at Upsala, whose observations have reference, among other points, to the following, viz.:—The blossoming and fruiting, coming into leaf, and fall of the leaf, of trees and plants; the commencement and termination of the various field works of agriculture; the arrival and departure of birds of passage; the occurrence of night-frosts and their effect upon vegetation; the freezing and thawing of streams and watercourses; rainfall; and thunderstorms. When filled up, the forms are forwarded to Professor Hildebrandsson at Upsala, under whose supervision they are digested and tabulated.

I am informed that the observations on rainfall are made with instruments provided by the Meteorological Department; but of these instruments, as well as of the forms on which the returns are made, I have no details. The other forms appear very suitable to the purpose for which they are intended; and they possess the great merit of not attempting too much, but being just such as any observer of ordinary intelligence can easily and correctly fill up. I venture to characterise this as a feature of great merit, because it widens the sphere of possible observations in a very appreciable degree, by bringing them within the capacity of a large class of persons, without making any extensive demands upon their time, or requiring any special scientific ability.

Charts are compiled from the returns, and exhibit in an extremely interesting graphic form the track and principal phenomena of thunderstorms. I should have been glad to exhibit one containing a representation of two or more

successive storms occurring on the same day, but have not been able to procure one.

While regretting the meagreness of the present communication, I venture to hope that it may suffice to indicate the general mode of procedure, and to afford a basis for further inquiry into details should the Society find the question of interest.

JUNE 15th, 1881.

Ordinary Meeting.

GEORGE JAMES SYMONS, F.R.S., President, in the Chair.

FREDERICK CROWLEY, Ashdell, Alton;
ALFRED M. DAVIS, Sussex House, Addiscombe, Croydon;
REV. RICHARD DRAKE, Stourmouth Rectory, Sandwich;
FREDERICK HUSSEY DANIEL EYRE, The Lawn, Mudeford, Christchurch;
WALTER MATTHEW GIBSON, Privy Purse Office, Buckingham Palace, S.W.;
EDWARD WINDUS MATHEW, J.P., D.L., Wern, Stoke, near Guildford;
JOHN PARNELL, M.A., F.R.A.S., 1 The Common, Upper Clapton, E.;
JOHN RIGBY, 89 Hampden Street, Bolton;
THOMAS GLAZEBROOK RYLANDS, F.L.S., F.G.S., Highfield, Thelwall, Warrington;
HAROLD SMITH, Fulford House, Beverley Road, Hull; and
ALFRED HOPE WOOD, The Hollies, Hastings,
were balloted for and duly elected Fellows of the Society.

The following Papers were read:—

THE USE OF SYNCHRONOUS METEOROLOGICAL CHARTS FOR DETERMINING MEAN VALUES OVER THE OCEAN. By CHARLES HARDING, F.M.S. (p. 216.)

THE CLIMATE OF FIJI. By ROBERT LONGLEY HOLMES, F.M.S. (p. 222.)

NOTE ON THE FORMATION OF HAIL. By J. A. WESTWOOD OLIVER.

IT is my object in this note to call attention to a theory of the formation of hail suggested by M. Oltramare in a paper communicated to the Paris Academy of Sciences, in April 1879. This theory, in my opinion, is the most satisfactory that has yet been propounded.

About the same time that M. Oltramare sent his paper to the Paris Academy, Lord Rayleigh, F.R.S., communicated one to the Royal Society on the influence of electricity on colliding water drops. He experimented with fine jets of water ascending in a nearly vertical direction. In its normal state a jet resolved itself into drops, which were scattered to a considerable width; when feebly electrified, the drops became coherent, and coalesced; when powerfully electrified, they became mutually repellent, and were scattered more widely than at first. If we apply these results to cloud-particles, the important influence of electricity upon the precipitation of moisture is at once apparent. Suppose a body of saturated air to be cooled by some means; upon the electrical tension of the condensed moisture which results, depends whether it fall at once or remain suspended in the air as a visible cloud. If the tension be small, the particles coalesce, form drops, and descend as rain; if the tension be great, the particles repel one another and form cloud masses—probably of the *cumulus* description.

The experiments and observations of Dufour, Fournet, Jamin and others, have proved that small particles of water, such as compose fogs and mists, may be reduced in temperature to —14° C., or even to —20°, without being congealed, provided they be not agitated in the least. When in this condition of *superfusion*, the slightest concussion or shock causes the particles to assume the solid state. We may hence suppose an electrified cloud to have its temperature reduced to —14° C. without any change taking place in its condition. But in its electricity

we have a disturbing force which may operate to change its state of surfusion into one of congelation. We have seen that the individual particles are kept apart by repulsion, due to the electricity with which the cloud is charged. Should this electricity be abstracted (say by a discharge) the repelling force is gone, and the particles coalescing create the agitation necessary for their solidification, and form hailstones.

M. Oltramare's theory may be enunciated thus :—Let a cloud be (1) electrified and (2) cooled below the freezing point: the discharge of electricity allows the constituent particles to unite ; and the resulting commotion causes instantaneous congelation.

In 1877, M. Pictet described some experiments upon the appearance of ice formed at different temperatures. He found that between 0° C. and —1°·5 it is perfectly transparent. If the water be cooled below —3°, however, the ice becomes *opaque* and white. The opacity of the ice that forms hailstones has been universally observed. Indeed, I am only aware of one instance of a transparent hailstone, and that occurred under exceptional circumstances. The hardness, and often transparency, of the outer coating may be referred to the partial fusion undergone in passing through the stratum of warm air near the earth's surface. That such is the effect of a high temperature on white ice was well shown in a hailstorm described by Mr. H. Abich. The stones when they fell were opaque and crusted with crystals, but after lying on the ground for a night they became perfectly transparent.

I shall not attempt to reconcile this hypothesis with facts, for the "facts," as we at present know them, are not a fair test of a theory. The most absurdly contradictory statements are to be found in books professing to speak with authority. It is asserted, for example, in one place, that hail occurs most frequently in summer; in another, that winter is pre-eminently the hail season; and in yet another, that all seasons are alike in that respect! I am at present engaged in collecting observations ; and when I have deduced from these any generalities that may make themselves apparent, I shall again come before the Society with a more complete discussion of the subject. In the mean time, might I request Fellows to assist me by forwarding any particulars of hailstorms which they may happen to possess? The most important points to be noted are as follow :—

1. Date and hour of the day.
2. Area of storm. If in the form of a path, give (*a*) length, (*b*) breadth, (*c*) direction of course, (*d*) rate of progression.
3. Physical features of the locality, (*a*) elevation, (*b*) mountains, (*c*) rivers and valleys, (*d*) trees, &c.
4. Temperature, (*a*) before the storm, (*b*) after the storm.
5. Barometer readings.
6. Wind, (*a*) direction near the earth's surface, (*b*) direction in higher regions as indicated by the cloud motion, (*c*) force.
7. Preceded or followed by rain.
8. Aspect of the clouds. Note if there be any appearance of two separate strata at different elevations.
9. Electrical phenomena. If there be any lightning, note whether the electric discharges precede the fall of hail, or *vice versâ*.
10. Duration of the storm at one spot.
11. Configuration and size of the hailstones.
12. Sound. Note if any sound like rustling precedes the fall.
13. General character of the weather before and after the storm.

NOTES.

1. This point is somewhat important. The maximum period seems to vary in different countries. In Germany and Switzerland it is spring. In this country Howard says that it is summer, and Dalton, winter. I strongly suspect, however, that Dalton and other observers who have arrived at the same result included what is called in French *grésil*. Small round pellets of powdery snow often fall in cold weather in winter. It is not hail proper, although often called hail, and should not be included in enumerating hail-falls.
2. Hailstorms are generally local. When not so, they travel in very sharply

defined bands. The French storm of 1788 is the best example of a progressive storm.

3. The elevation at which hail occurs is very remarkable. It has been encountered in the Himalayas, the Alps, the Andes, and the Pyrenees. Mountains seem to exercise some occult influence in the production of hail. The unenviable distinction which Southern France enjoys of being pre-eminently the hail-country of the world has been attributed to the proximity of the Alps and Pyrenees. It is important to note the conformation of the ground. When not at a great height, hailstorms have shown a tendency to follow the direction of rivers. It is also said that trees have the effect of diminishing the hail fall. This is very singular, as forests have exactly a contrary effect upon the precipitation of rain.
4. The temperature is often very high some time before a storm, but it rapidly sinks on its near approach.
5. The barometer has been known to descend 1·15 in. before a hailstorm.
6. Conflicting currents of wind have been so frequently observed that Kämtz went the length of ascribing the formation of hail to their action.
7. Hail is sometimes preceded and sometimes followed by rain. It is a point of some importance.
8. Arago was the first to point out the peculiar ashen hue of hail-clouds. It is important to note if there be more than one stratum of cloud, as Volta and others have based theories upon that assumption.
9. The intimate connection between hail and electricity has long been observed, and electrical theories are accordingly numerous. Sir John Herschel was of opinion that electricity is one of the effects rather than the cause of the formation of hail.
13. Sir John Herschel says that hail generally *precedes* storms, but rarely or never follows them. My own observations point to the directly opposite conclusion.

Particulars of the damage done by hailstorms to crops, &c. are interesting, and may be appended.

Mr. ARCHIBALD said he had frequently seen hailstones in Bengal as large as walnuts. Hailstorms in that region generally occurred in March and April. There was one point about hailstorms which he had frequently observed in India, and which any theory of their origin, to be satisfactory, must explain, viz. that the largest stones always fall at the end of a storm. According to one theory this was supposed to be due to their rapid oscillation between warm and cold strata.

NOTE ON A COMPARISON OF MAXIMUM AND MINIMUM TEMPERATURE AND RAINFALL OBSERVED ON TABLE MOUNTAIN, AND AT THE ROYAL OBSERVATORY, CAPE TOWN, DURING JANUARY AND FEBRUARY 1881. By JOHN G. GAMBLE, M.A., M.Inst.C.E., F.M.S.

DURING the months of January and February of this year I have had a party of assistants surveying on Table Mountain. They observed the maximum and minimum thermometers, and I give the result of their observations side by side with those observed at the Royal Observatory.

The difference between the mean of the maxima as observed on Table Mountain and the mean of the maxima observed on the same days at the Observatory is 12°. The difference between the mean of the minima is 5°. On one occasion the temperature was higher in day time on Table Mountain than at the Observatory, and on one occasion only the temperature at the Observatory at night was lower than that on the mountain. The maximum temperature on the mountain when covered with "south-east cloud" is 60°. On very clear calm days the temperature on the mountain is nearly as high as that at the Observatory. The camp was about 1,100 feet below the highest point of Table Mountain. I also give a comparative statement of the rainfall from January 18th to the end of March observed at the two stations.

I have left a rain-gauge up there, and am having a special cistern constructed so as to hold a month's rain, so that I hope to be able to continue registering the rainfall from time to time. It will be seen that the rainfall on the mountain in summer is very much in excess of that at the Royal Observatory. It will be

interesting to find out what the comparative fall is in winter time, our rainy season.

Observations of Maximum and Minimum Thermometers at the Royal Observatory, Cape Town, 37 feet above Sea Level, and in a Tent on Table Mountain, 2,470 feet above Sea Level.

1881.	Max.		Min.		1881.	Max.		Min.		1881.	Max.		Min.	
	Table Mountain.	Royal Observatory.	Table Mountain.	Royal Observatory.		Table Mountain.	Royal Observatory.	Table Mountain.	Royal Observatory.		Table Mountain.	Royal Observatory.	Table Mountain.	Royal Observatory.
	°	°	°	°		°	°	°	°		°	°	°	°
Jan. 18	87	86	55	61	Jan. 30	73	87	49	62	Feb. 11	59	74	51	43
19	..	..	50	61	31	92	99	56	60	12	59	82	44	47
20	61	80	54	60	Feb. 1	..	93	..	60	13	72	86	50	66
21	62	79	52	63	2	75	89	51	56	14	95	103	55	58
22	71	85	53	57	3	..	88	46	58	15	87	89	61	59
23	78	84	51	64	4	88	91	56	60	16	69	79	54	59
24	74	88	55	64	5	78	79	56	62	17	61	77	51	57
25	75	87	56	62	6	61	79	56	60	18	58	82	48	60
26	71	84	55	57	7	71	83	52	61	19	66	82	52	61
27	91	95	55	67	8	68	85	51	59	20	72	82	53	61
28	86	95	55	..	9	78	79	48	58					
29	59	81	51	55	10	86	90	54	56	Means	73	85	54	59

Rainfall as observed at the Royal Observatory, Cape Town (37 feet above Sea Level), and at Camp on Table Mountain, 2,470 feet above Sea Level.

1881.	Table Mountain.	Royal Observatory.	1881.	Table Mountain.	Royal Observatory.
	In.	In.		In.	In.
Jan. 18—28 ..	·00	·00	Feb. 22—28	·10	·00
„ 29	·05	·00	March 1— 4	·11	·05
„ 29—Feb. 5	·00	·00	„ 5—11	·00	·00
Feb. 7 ..	·08	·02	„ 12—18	·32	·15
„ 8—10 ..	·00	·00	„ 19—24	·44	·18
„ 11	·28	·03	„ 24—27	·00	·00
„ 12—16 ..	·00	·00			
„ 17	·84	·06		·97	·38
„ 18—21 ..	·00	·00			
			Total of Rainfall, Jan.		
	1·25	·11	18—March 27	2·22	0·49

Mr. E. J. SPITTA exhibited and described a new mercurial maximum and minimum registering thermometer.

RECENT PUBLICATIONS.

ANNUAIRE DE LA SOCIÉTÉ MÉTÉOROLOGIQUE DE FRANCE. 29me Année, 1881. 1er Trimèstre. 4to. 1881.

Contains :—Note sur le commencement de l'hiver de 1881, par E. Renou (1 p.).—Note de M. Aitken sur la formation des brouillards (2 pp).—Note sur une conférence de M. Mascart sur la prévision du temps, par Th. Moureaux (5 pp.).—Sur la prévision du temps dans le département de la Meuse, par M. Poincaré (3 pp.).—Etudes sur les lois des grands mouvements de l'atmosphère et sur la formation et la translation des tourbillons aériens, par F. F. Hébert (62 pp.).

ANNUAIRE MÉTÉOROLOGIQUE POUR L'ANNÉE 1880. Publié par l'Institut météorologique Danois. Première partie. 1881. Folio.

In addition to the usual tables of results of observations made in Denmark, there is also a paper by Philip Weilbach on the Classification of Clouds, accompanied by plates giving twelve representations of different forms of clouds.

BIBLIOTHÈQUE UNIVERSELLE. ARCHIVES DES SCIENCES PHYSIQUES ET NATURELLES. Troisième Période. Tome VI. No. 9. September 1881. 8vo.

Contains two papers by Prof. D. Colladon, viz.—1. Note sur quelques expériences faites en 1826 sur les courants électriques produits par des éclairs éloignés et sur une observation de M. René Thury relative aux bruits des téléphones pendant les orages (4 pp.).—2. Déviations de la foudre dans une campagne située aux environs de Genève (12 pp.).

CIEL ET TERRE. REVUE POPULAIRE D'ASTRONOMIE ET DE MÉTÉOROLOGIE. Vol. II. August to October, 1881. 8vo.

The chief meteorological articles are :—Quelques phénomènes météorologiques dans leurs manifestations extrêmes, par A. Lancaster (28 pp.).—Les grandes chaleurs de juillet, 1881, par A. Lancaster (5 pp.).—Un climat désagréable, par J. Vincent (5 pp.).—Expériences sur la vitesse du vent à différentes hauteurs, par C. Lagrange (11 pp.).—Projet de Télémétéorographie internationale, par F. Van Ryssebergbe (8 pp.).

INDIAN METEOROLOGICAL MEMOIRS : being occasional Discussions and Compilations of Meteorological Data relating to INDIA AND THE NEIGHBOURING COUNTRIES. Published under the direction of HENRY F. BLANFORD, Meteorological Reporter to the Government of India. Vol. I. Part V. 4to. 1881.

Contains :—Some Results of the Meteorological Observations taken at Allahabad during the ten years, 1870-79, by S. A. Hill, B.Sc. (47 pp.).—The Diurnal Variation of the Barometer at Indian Stations. Part II.; Goalpara, Patna, and Leh, by H. F. Blanford, F.R.S. (17 pp.).

JOURNAL OF THE ASIATIC SOCIETY OF BENGAL. Vol. L. Part II. 1881. 8vo.

Contains two papers by Mr. H. F. Blanford, F.R.S., viz.—1. Description of a rain-gauge with evapometer, for remote and secluded stations (3 pp.).—2. On the relations of cloud and rainfall to temperature in India, and on the opposite variations of density in the higher and lower atmospheric strata (15 pp.).

MAGNETICAL AND METEOROLOGICAL OBSERVATIONS MADE AT THE GOVERNMENT OBSERVATORY, BOMBAY, IN THE YEARS 1871 to 1878. Under the superintendence of CHARLES CHAMBERS, F.R.S., and F. CHAMBERS. 4to. 1881. 288 pp.

The Magnetical and Meteorological Observatory at Colaba was instituted by the Honourable East India Company in 1841 ; and from 1845 to 1864, a large quarto volume was published each year, giving the hourly meteorological observations *in extenso*. The next volume contained abstracts of results only of the hourly observations for the years 1865 to 1870. The present volume brings on the record to 1878.

NOVA ACTA REGIÆ SOCIETATIS SCIENTIARUM UPSALIENSIS. Ser. III. 1881. 4to.

Contains :—Recherches sur les Phénomènes Périodiques des Plantes, par R. Hult (51 pp., with 3 plates).

REPORT OF THE IOWA WEATHER SERVICE FOR THE YEAR 1881. By Dr. GUSTAVUS HINRICHS, Director. 8vo. 1881. 16 pp.

This contains the results of the rainfall observations for the first lustrum of the Service, 1876-80, with rainfall maps for each year and for the lustrum. The

rain maps show that the amount of rainfall in Iowa is largely influenced by the distribution of timber, the annual rainfall increasing with the amount of timber or foliage in the different portions of the State.

THE CLIMATE OF THE UNDERCLIFF, ISLE OF WIGHT, AS DEDUCED FROM FORTY YEARS' CONSECUTIVE METEOROLOGICAL OBSERVATIONS. By J. L. WHITEHEAD, M.D. 8vo. 1881. 46 pp.

This contains the results of the observations made by the late Dr. Martin, of Ventnor, and his brother, Mr. Martin, M.R.C.S., which extend from 1840 to 1879.

THE OCEAN AS A HEALTH RESORT. A Practical Handbook of the Sea for the use of Tourists and Health-Seekers. By WILLIAM S. WILSON, L.R.C.P. With a Chart showing the Ocean-routes and illustrating the Physical Geography of the Sea. Second Edition. 8vo. 1881. 351 pp.

Chapter XIV., "The Meteorology of the Ocean," has been compiled by Mr. E. Mawley, and treats of the following:—Instruments required for taking observations—Barometer — Thermometer — Thermometer screen — Hygrometer—Method of determining the humidity of the air — Observations of shade temperature—Surface temperature of the sea—The meteorological journal—Estimation of the amount of cloud—Direction and force of the wind—Observations of rainfall not reliable—Special meteorological conditions at sea—Distribution of storms—Log and meteorological tables of a voyage to Australia—Log, meteorological tables, and weather report of homeward voyage by Cape of Good Hope.

TRANSACTIONS OF THE HERTFORDSHIRE NATURAL HISTORY SOCIETY AND FIELD CLUB. Vol. I. Part 5. July 1881. 8vo.

Contains two meteorological papers, viz.—1. Rainfall in Hertfordshire, 1840-79, by the Rev. C. W. Harvey (8 pp.); and 2. On the Occurrence of Red Snow in Hertfordshire, by Lieut. R. B. Croft, R.N. (3 pp.).

ZEITSCHRIFT DER OESTERREICHISCHEN GESELLSCHAFT FÜR METEOROLOGIE. Redigirt von DR. J. HANN. XVI. Band. August to October, 1881. 8vo.

Contains:—Ueber den eisenhaltigen Staub im Schnee, von Dr. J. H. L. Flögel (10 pp.).—Thermische Vegetationsconstanten, von H. Hoffmann (3 pp.).—Untersuchungen über die Regenverhältnisse von Oesterreich-Ungarn, Part II. von Dr. J. Hann (6 pp.).—Die meteorologischen Beobachtungen während der Vega-Expedition von Nordkap bis Yokohama durch die Meerenge Behring, von Dr. H. H. Hildebrandsson (10 pp.).—Zug der oberen Wolken im Verhältniss zur unteren Druck-und Wärmevertheilung, von A. Richter (3 pp.).—Von den magnetischen Verhältnissen in den arktischen Gegenden, von Dr. A. Wijkander (8 pp.).—Ueber die Gesteinstemperaturbeobachtungen im Formanschacht, Virginia City, Nevada, von Dr. F. M. Stapff (4 pp.).—Die geographische Vertheilung und Bewegung, das Entstehen und Verschwinden der barometrischen Minima in den Jahren 1876 bis 1880, von Dr. van Bebber (6 pp.).—Eine periodische Erscheinung im täglichen Gange der Windrichtung, von Dr. A. Sprung (5 pp.).

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THE END.

METEOROLOGY OF ENGLAND,

DURING THE QUARTER ENDING MARCH 31, 1881.

REMARKS ON THE WEATHER DURING THE QUARTER ENDING MARCH 31ST, 1881.

By JAMES GLAISHER, ESQ., F.R.S., *&c.*

THE weather in January for the first few days was fine, but on the 7th a period of exceptionally bad weather set in, which from the 12th to the 27th was remarkable for its severity. Snow fell on every day from the 9th to the 27th, with the exception of the 25th; south of the latitude of 51° it fell on 14 days, and in other parallels of latitude on from 10 to 13 days; on some days the fall was general. Fog was very prevalent, south of latitude 51° it occurred on six days, and at stations north of 52° on 18 days; at Bradford there were dense fogs on the 24th, 25th, and 26th. The east and N.E. winds were in excess.

The mean temperature of the month at all stations north of 51° 25′, with the exception of Lowestoft and Llandudno, was below 32°.

February was a wet, cold, gloomy month, with frequent falls of snow and an excess of east winds. Snow fell in Devonshire on four days, and at northern stations on 14 or 15 days. Fog was prevalent at all stations.

In March the weather was warm and genial from the 4th to the 20th, but cold at the beginning and the end of the month. Snow fell at Guernsey and in Cornwall on the 1st, and in the north of England on every day excepting between the 9th and 19th; it fell in Devonshire on the 21st, 26th, and 27th. From the 4th to the 20th the wind was chiefly from the west, and at the beginning and at the end of the month, from the east.

The mean daily temperature of the air was above the average till January 6th; the average daily excess being 2°·5; from the 7th to the 27th it was below the average, and on some days to the extent of 15° and 16°, the average deficiency for the 20 days ending January 27th being 9°·7; from January 28th to February 10th, the average daily excess was 3°·4; a cold period then again set in, but it was of less severity than that ending January 27th, the average deficiency of daily temperature for the 21 days ending March 3rd being 3°·6; from March 4th to 20th, there was an average excess of daily temperature of 6°, and from March 21st to the end of the quarter, the weather was cold, the average deficiency of daily temperature being 4°.

The falls of snow throughout the quarter were exceptional; snow fell on 53 days, and the snowstorm of the 18th day of January was very remarkable; this day was bitterly cold and there was a gale from the east, with driving snow that penetrated everywhere. The snow began to fall about 9.0 a.m., and at midnight, at Blackheath, in places free from drift, it was 15 inches in depth; nearly all the lines of railway out of London were blocked, and some of them early in the afternoon; trains were embedded in the snow all night and during the next day. This snowstorm extended southward to Jersey and Guernsey, where the depth was from 12 ins. to 14 ins., with drifts up to four and five feet. In the Isle of Wight the depth was about 15 ins., and Mr. Mann says the island was white with snow from the 17th to the 29th; a second heavy fall of 18 ins. having taken place on the 20th; the total depth of snow which fell on these two days was therefore 33 ins. On the 18th day the depth of snow at Brighton was 18 ins.; in Cornwall and Devonshire it was from 12 to 14 ins., with drifts of from 10 to 12 feet; the amounts were less proceeding northwards, at Cambridge the depth was eight inches, and at Leeds and Bradford, the fall was very small. The loss of life in England due to the snow was great, and small birds died in great numbers, their food being covered by the snow. Dr. Compton, of South Bourne, says, "Rooks were seen to kill "and eat sparrows, and blackbirds to eat each other on my lawn, where a great congregation of "birds were collected."

The mean temperature of the month was also exceptional, being slightly lower than the cold January of 1879, and lower than any January since 1838. The month was, however, chiefly remarkable on account of the succession of very low temperatures in Cornwall and Devonshire.

The table on the next page shows the minimum temperatures at the several stations from January 12th to January 28th. The lowest temperatures on the days were, on the 12th, 12°·5 at Carlisle and Stockton; on the 13th, 11°·5 at Marlborough; on the 14th, 4°·0 at Carlisle; on the 15th, 0°·5 at Carlisle; on the 16th, −5°·5 at Carlisle; on the 17th, −2°·0 at Carlisle; on the 18th, 5°·6 at Carlisle; on the 19th, 16° at Bradford; on the 20th, 3° at Stockton; on the 21st, −2° at Cambridge; on the 22nd, 1°·0 at Cardington; on the 23rd, 8°·8 at Totnes; on the 24th, 4°·2 at Carlisle; on the 25th, 7°·3 at Wrottesley; on the 26th, 2°·2 at Carlisle; on the 27th, 7°·2 at Carlisle; and on the 28th, 25° at Bywell, but on this day the reading was 32° or higher at nearly every other station. An examination of the table line by line shows the lowest temperature at each station; at Guernsey the lowest was 24°·5 on the 16th; at Truro it was 12° on the 15th, and there were several readings below 20°; the lowest at Eastbourne was 12°·8, at Plymouth 17°, at Totnes 8°·8, at Torquay 15°·3, at Ventnor 14°·6, at Osborne 12°, at Bournemouth 12°·1, at Brighton 11°·4, at Salisbury 2°·5, at Barnstaple 8°, at Bath 8°·8, at Ramsgate 15°, at Strathfield 4°·9, at Marlborough 6°·9, at Bristol 9°, at Whitchurch 5°·3°. All these stations are south of London, and the low temperatures recorded at them are therefore very remarkable.

At *Blackheath* the *pressure of the atmosphere* was above its average till January 10th, the average daily excess being 0·40 in.; from the 11th to the 20th it was below its average, the average daily deficiency being 0·28 in. (on the 18th the deficiency was as much as 0·74); it was

slightly above its average on the 23rd, 24th, and 25th; from January 26th to February 17th there was an average daily deficiency of 0·29 in.; from February 28th to 25th there was an average daily excess of 0·16 in. daily; from February 26th to March 14th there was an average daily deficiency of 0·023 in.; from March 14th to 19th, an average daily excess of 0·30 in.; and from this date to the end of the quarter there was a mean daily deficiency of 0·21 in.

TABLE showing the MINIMUM TEMPERATURE of the AIR at the several Stations on January 12th to January 28th.

Names of Stations.	JANUARY, 1881.																
	12th.	13th.	14th.	15th.	16th.	17th.	18th.	19th.	20th.	21st.	22nd.	23rd.	24th.	25th.	26th.	27th.	28th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Guernsey	35·0	30	35·0	32·0	24·5	26·0	32·0	31·0	28·5	27·0	26·0	27·0	32·0	27	29·5	29·5	45·0
Truro	29·0	9·0	21·0	12·0	14·0	21·0	23·0	21·0	16·0	16·0	19·0	15·0	27·0	26	23·0	27·0	37·0
Eastbourne	30·0	22·7	22·3	16·8	20·0	13·8	2·4	26·3	20·7	22·8	13·8	13·7	28·0	19	20·3	31·7	36·0
Plymouth	31·0	19·8	9·0	20·0	17·3	19·1	27·5	25·0	17·0	18·0	18·8	19·1	27·5	25·5	22·0	28·8	38·2
Totnes	27·4	15·4	4·5	12·3	12·3	13·7	25·7	20·7	8·8	15·6	11·5	8·8	25·7	19·4	19·4	33·0	36·5
Torquay	25·0	22·8	24·6	18·2	20·6	18·0	25·2	23·7	15·3	19·8	17·0	25·4	31·0	19·3	19·7	33·2	36·3
Ventnor	30·5	24·9	24·0	21·5	21·9	23·8	27·2	26·6	17·9	22·7	14·6	15·9	23·6	20·0	24·3	29·8	38·1
Osborne	27·7	20·8	18·8	15·8	16·6	16·0	24·1	24·7	15·5	18·0	12·0	16·1	15·0	20	20·5	24·0	33·0
Bournemouth	28·0	22	19·0	15·0	18·2	14·1	26·2	25·1	14·1	18·2	12·2	19·1	12·1	15·3	27·0	30·4	36·1
Brighton	25·4	22	20·7	15·5	19·0	16·7	24·4	26·2	17·3	18·4	11·4	25·4	30·0	18·0	21·0	33·9	35·3
Salisbury	20·0	16·0	3·0	7·0	7·5	6·5	14·0	9·5	10·5	14·0	5·5	14·0	15·0	14·0	11·0	20·5	33·0
Barnstaple	31·0	14·0	14·0	9·0	14·0	16·0	28·0	26·0	14·0	11·0	18·0	19·0	26·0	15·0	8·0	20·0	36·0
Bath	29·0	15	13·8	8·8	14·1	14·7	—	—	14·8	15·2	13·5	—	14·4	14·8	15	33·4	34·9
Ramsgate	25·8	26	26·5	18·0	15·5	15·1	25·1	25·6	23·1	24·1	15·5	27·2	24·9	13·2	21	29·0	35·5
Strathfield Turgiss	21·9	17	11·5	8·1	13·4	6·7	18·6	24·7	9·6	8·9	8·9	13·3	4·9	15·2	12·5	23·2	32·6
Marlborough	19·7	7·5	12·2	6·9	8·5	9·5	21·2	23·2	11·7	16·2	12·6	23·7	11·7	16·8	17·4	29·2	34·6
Bristol	25·2	22	14·5	9·0	10·5	15·6	21·0	24·0	13·5	19·0	13·5	27·0	18·0	14·0	15	25·0	34·5
Blackheath	25·0	2	15·0	15·0	14·0	13·0	25·9	25·6	16·5	9·2	17·5	30·2	24·0	18·6	15	33·0	34·5
Whitehurch	21·0	21·5	14·9	9·0	11·2	5·3	11·0	27·0	12·0	10·0	10·0	11 0	10·0	19·6	20·8	21·4	34·4
Greenwich	23·0	19	15·0	14·0	17·7	12·7	26·2	25·5	14·4	15·8	17·3	30·0	23·3	16·8	13·2	33·5	34·9
Camden Square	28·4	19·8	19·4	12·2	14·2	11·8	15·7	22·2	18·5	15·7	15·2	15·4	23·8	21	17·5	19·4	33·8
Oxford	23·9	17·4	1·3	8·7	12·8	9·8	21·8	24·2	11·7	9·2	6·2	17·2	10·2	15	17·7	19·7	34·8
Royston	20·7	19·7	12·	13·0	14·7	14·0	20·6	22·8	—	7·9	7·7	20·4	14·9	18	13·7	15·2	32·3
Gloucester	23·0	19·0		7·5	8·0	12·0	20·0	23·0	6·0	7·0	9·5	12·5	8·0		15·0	15·0	32·5
Cardington	30·6	19·6	12·0	11·0	12·6	9·6	12·0	24·0	9·6	0·0	1·0	18·0	23·4	19	18·6	13·0	33·2
Somerleyton	22·4	20·4	18·6	7·7	12·0	8·0	14·5	23·5	23·4	12·5	14·0	23·7	20·0		8	33·0	34·6
Lowestoft	22·9	20·6	21·0	9·2	10·0	14·1	28·5	25·0	22·7	19·0	13·9	29·0	21·3	14·0	21·8	33·6	34·8
Cambridge	24·0	21·0	2·0	13·0	15·0	13·0	21·0	24·2	16·2	−2·0	4·9	29·3	18·1	18	15·0	24·0	33·7
Stockton	12·5	19·0	7·0	7·0	10·0	11·0	22·0	23·5	3·0	10·0	5·0	14·0	4·5	12·0	15·0	15·0	32·9
Norwich	24·0	24·8	4·0	11·0	11·0	16·0	25·0	24·0	22·0	15·0	12·0	25·0	20·0	14	8·5	32·0	34·0
Leicester	20·0	20·0	4·7	5·2	10·0	12·8	24·0	23·5	11·0	11·0	10·5	21·0	10·4	10	15·5	27·5	33·0
Birmingham	—	—		—	15·0	15·7	16·6	25·0	16·0	11·4	13·3	—	—		—	—	—
Wrottesley	15·3	16·4	9·6	6·8	4·3	14·5	17·7	23·8	9·1	9·3	8·1	16·4	12·0	2	9·5	17·5	23·6
Nottingham	14·5	18·0	13·	1·7	6·0	7·0	10·2	23·9	9·2	11·0	12·0	15·7	17·0	2	1·4	16·5	23·4
Holkham	20·6	20·1	10·6	10·9	11·5	10·8	15·5	22·4	23·3	8·4	15·9	23·6	10·3	5·2	4·6	10·3	31·2
Llandudno	27·3	27·7	18·4	17·6	17·8	22·5	25·2	27·1	20·2	16·5	18·0	30·6	27·2	24·8	14·5	30·0	31·0
Sheffield	22·0	26·3	13·8	15·0	17·4	14·5	16·3	24·5	18·0	18·0	14·0	29·0	17·5	10·9	11·0	21·4	32·1
Liverpool	28·5	27·7	2·	15·9	10·0	11·4	19·0	27·5	21·2	19·6	20·0	19·9	20·0	7·6	8·5	17·3	32·6
Bolton	16·9	16·3	16·9	10·8	0·8	16·0	16·2	19·2	15·3	13·0	18·3	29·0	20·0	16·0	9·0	12·7	32·0
Halifax	18·0	22·0	5·2	15·0	13·0	15·0	14·0	25·0	9·0	18·0	19·2	25·0	20·5	3·0	10·0	20·0	30·5
Hull	20·0	21·0	7·0	7·0	15·0	10·0	9·0	24·0	14·0	6·0	16·0	22·0	16·0	5·6	12·0	25·0	31·0
Stonyhurst	18·0	16·3	12·0	5·5	10·0	18·8	27·0	13·3	17·0	14·5	19·2	18·2	14·0	10·0	13·3	31·0	34·0
Bradford	22·0	24·8	19·5	16·0	15·0	20·0	16·1	16·0	20·0	20·0	21·7	27·0	24·0	15·2	12·0	17·5	29·1
Leeds	21·0	27·0	18·0	17·0	17·0	20·0	15·0	28·0	20·0	19·0	23·0	28·0	26·0	18·0	12·0	23·0	32·0
Cockermouth	13·2	23·6	9·0	7·2	4·0	7·9	20·2	22·7	10·9	11·4	8·9	23·9	11·1	10·9	5·8	15·3	29·6
Silloth	15·0	17·4	5·9	5·2	0·0	10·0	19·5	25·7	16·0	10·0	9·1	21·2	7·4	8·5	5·7	15·0	32·7
Sunderland	24·0	26·0	23·0	20·0	20·0	11·0	13·0	27·0	25·0	20·0	20·0	26·0	17·0	20·0	14·0	18·0	32·0
Carlisle	12·5	13·2	4·0	0·5	−5·5	−2·0	5·6	28·3	12·3	2·2	4·2	14·0	4·2	7·5	2·2	1·2	31·5
Rywoll	17·0	20·0	19·0	9·0	8·0	7·0	9·0	26·0	25·0	9·0	20·0	9·0	12·0	15·0	10·0	8·0	25·0
North Shields	21·5	27·7	16·0	13·7	11·8	7·7	14·5	27·0	23·8	16·0	19·0	29·0	15·0	15·0	6·0	20·0	33·5

The mean reading of the barometer for the month of January was 29·710 ins., being 0·056 in. below the average; that for February was 29·661 ins., being 0·125 in. below the average; and that for March was 29·728 ins., being 0·019 in. below the average.

The atmospheric pressure in January was less than in December by 0·084 in., that in February was less than in January by 0·049 in., and that in March greater than in February by 0·067 in. (From the preceding 40 years' observations the mean pressure in January is less than in December by 0·027, that in February is greater than in January by 0·019, and that in March is less than in February by 0·039 in.) There was a decrease of atmospheric pressure from December to January at all stations south of latitude 53°, and an increase north of this parallel; the decrease was about 0·1 in. at extreme southern stations, there was no change at 53°, and beyond this parallel there was a gradual increase amounting to 0·11 in. at extreme northern stations. From January to February there was a decrease everywhere, this decrease being greater at northern than at southern stations. From February to March there was an increase at all stations, the amount of which decreased from 0·1 in. in Cornwall and Devonshire to 0·01 in. at latitude 55°.

At *Blackheath* the *mean temperature* of January was lower than that of December by 11°·3; that of February was higher than that of January by 6°·1; and that of March was higher than that of February by 4°·9. (From the preceding 40 years' observations the mean temperature of January is 1°·5 lower than that of December, that of February is 1°·1 higher than that of January, and that of March is 2°·2 higher than that of February.)

The mean decrease of temperature from all stations from December to January varied from 11° to 12°; from January to February there was an increase of 6° to 8° at all stations; and from February to March there was an increase of 3° to 4° at all stations south of latitude 54°, and of 1° to 2° north of this parallel.

1881. Months.	Temperature of Air. Mean.	Air. Diff. from average of 110 years.	Air. Diff. from average of 40 years.	Evaporation. Mean.	Evaporation. Diff. from average of 40 years.	Dew Point. Mean.	Dew Point. Diff. from average of 40 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 40 years.	Water of the Thames.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 40 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour in a Cubic Foot of Air. Diff. from average of 40 years.
	°	°	°	°	°	°	°	°	°	°	in.	in.	grs.	gr.
Jan. -	31·6	−4·9	−6·8	30·6	−6·4	28·0	−6·9	8·8	−0·8	..	0·153	−0·047	1·8	−0·5
Feb. -	37·7	−0·9	−1·8	36·8	−1·4	34·4	−0·8	9·0	−2·2	..	0·199	−0·009	2·3	−0·1
Mar. -	42·6	+1·5	+0·9	39·9	+0·6	36·6	+0·5	15·6	+1·0	..	0·217	+0·002	2·5	0·0
Means -	37·3	−1·4	−2·6	35·6	−2·4	33·0	−2·4	11·1	−0·7	..	0·170	−0·018	2·2	−0·2

1881. Months.	Degree of Humidity. Mean.	Degree of Humidity. Diff. from average of 40 years.	Reading of Barometer. Mean.	Reading of Barometer. Diff. from average of 40 years.	Weight of a Cubic Foot of Air. Mean.	Weight of a Cubic Foot of Air. Diff. from average of 40 years.	Rain. Amount.	Rain. Diff. from average of 66 years.	Daily Horizontal movement of the Air.	Reading of Thermometer on Grass. Number of Nights it was At or below 30°.	Between 30° and 40°.	Above 40°.	Lowest Reading at Night.	Highest Reading at Night.
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
Jan. -	86	−1	29·710	−0·056	561	+ 7	1·16	−0·74	256	27	4	0	10·2	38·0
Feb. -	88	+3	29·661	−0·125	553	0	2·43	+0·87	311	17	9	2	21·2	44·0
Mar. -	78	−4	29·728	−0·019	549	− 1	1·84	+0·29	336	16	12	8	20·1	47·2
Means -	84	−1	29·700	−0·067	554	+ 2	Sum 5·43	Sum +0·42	Mean 301	Sum 60	Sum 25	Sum 5	Lowest 10·2	Highest 47·2

NOTE.—In reading this table it will be borne in mind that the plus sign (+) signifies *above* the average, and that the minus sign (−) signifies *below* the average.

The average duration of the different directions of the wind referred to eight points of the compass, and the duration of each direction in each month in the quarter, were as follow:—

Direction of Wind.	January. Average.	January. 1881.	January. Departure from Average.	February. Average.	February. 1881.	February. Departure from Average.	March. Average.	March. 1881.	March. Departure from Average.
	d.	d.	d.	d.	d.	d.	d.	d.	d.
N.W.	1½	1½	0	2	3	+1	2¾	2	− ¾
N.	3	2	−1	3	3	0	3½	1	−2½
N.E.	3½	6½	+3	3½	4	+0½	4	3	−1
E.	½	6	+5½	2	5	+3	2½	7½	+5
S.E.	2	1	−1	1½	1	−0½	2	0	−2
S.	4	2½	−1½	3	2	−1	2½	2	− ½
S.W.	9½	7	−1½	8	3	−5	7½	6	−1½
W.	3½	5	+1½	2¾	7	+4¼	3¾	9½	+6¼
Calm (nearly.)	0	0	0	0	0	0	0	0	0

The sign (+) denotes excesses over averages; the largest numbers with this sign in January were E. and N.E., in February were E. and W., and in March were E. and W.

The sign (−) denotes defects below averages; the largest numbers with this sign in January were S. and S.W., in February was S.W., and in March were N. and S.W.

The mean temperature of the air for January was 31°·6, being 4°·9 and 6°·8 below the averages of 110 years and 40 years respectively. It was 1°·6 lower than in 1880, and 0°·3 lower than that in 1879, and was lower than that of any January since the year 1838. Other instances of low January temperatures are given in the *Quarterly Report* for March 1879.

The mean temperature of the air for February was 37°·7, being 0°·9 and 1°·8 below the averages of 110 years and 40 years respectively.

The mean temperature of the air for March was 42°·6, being 1°·5 and 0°·9 higher than the averages of 110 years and 40 years respectively.

The mean temperature of the air for the quarter was 37°·3, being 1°·4 and 2°·6 below the averages of 110 years and 40 years respectively.

The mean high day temperature of the air was 7°·1, and 3°·0 below the average in January and February respectively, and was 1°·2 above the average in March.

The mean low night temperature of the air was 9°·3, and 0°·9 below the average in January and February respectively, and 0·2 above the average in March.

Therefore the days and nights in January were very cold; the days and nights were cold in February, but the nights to a less degree than the days; and in March the days and nights were both a little above their averages.

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1881.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat^{n}. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a cubic foot of Air.						Estimated Strength.	Relative Proportion of						Number of Days it fell.	Amount collected.
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.			Maximum in Rays of Sun.	Minimum on Grass.		N.	E.	S.	W.				
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in.
SOMERLEYTON (Suffolk), The Rectory, Rev. C. J. Steward, F.M.S.	50	Jan.	29·842	1·748	48·0	4·8	43·2	34·0	25·1	8·9	37·3	28·0	·153	1·8	0·1	90	565	—	—	1·0	10	7	6	8	5·6	5·2	18	1·59
		Feb.	29·760	1·464	47·8	24·0	23·8	41·0	32·6	8·4	36·4	34·1	·198	2·2	0·3	92	536	—	—	1·0	7	8	7	6	7·5	7·3	20	2·75
		Mar.	29·824	1·302	60·5	22·0	38·5	48·6	34·9	13·7	40·6	37·9	·227	2·6	0·3	90	552	—	—	1·0	5	7	5	14	7·1	4·8	12	1·75
WOLVERHAMPTON (Staffordshire), Wrottesley, E. Simpson, Esq.	500	Jan.	29·285	1·724	45·6	4·3	41·3	35·4	21·3	12·1	27·4	24·3	·131	1·6	0·2	87	558	—	—	—	6	9	7	9	—	7·7	8	0·48
		Feb.	29·259	1·324	49·8	21·5	28·3	41·1	31·1	10·0	36·5	34·9	·203	2·3	0·2	93	546	—	—	—	6	10	7	5	—	8·4	15	2·88
		Mar.	29·308	1·326	57·3	19·6	37·7	47·1	33·0	14·1	39·5	34·8	·204	2·4	0·4	88	544	—	—	—	2	10	8	11	—	7·1	11	2·45
LEICESTER (Town Museum), W. J. Harrison, Esq., F.G.S.	238	Jan.	29·641	1·746	47·0	5·2	41·8	34·4	24·1	10·3	29·4	28·4	·144	1·7	0·2	89	562	51·0	20·2	0·8	11	9	6	5	—	7·4	10	0·59
		Feb.	29·546	1·470	51·0	25·3	25·7	41·7	33·7	8·0	37·6	35·2	·206	2·4	0·2	91	551	61·5	27·5	0·9	7	6	9	6	—	8·6	17	3·57
		Mar.	29·603	1·371	59·7	22·8	36·9	48·6	35·1	13·5	41·5	36·8	·219	2·5	0·5	84	547	91·0	27·1	1·1	6	6	9	10	—	6·4	14	1·49
NOTTINGHAM (Notts), M.O. Tarbotton, Esq., C.E., F.G.S., F.M.S.	183	Jan.	29·699	1·758	46·3	1·9	44·4	34·7	21·8	12·9	28·3	26·4	·143	1·7	0·2	93	564	56·4	20·9	0·2	10	11	6	4	—	7·4	15	0·52
		Feb.	29·609	1·418	52·0	23·1	28·9	42·0	32·5	9·5	37·0	34·6	·200	2·3	0·3	91	552	64·7	31·0	0·5	9	8	7	4	—	8·5	17	4·40
		Mar.	29·657	1·332	60·2	18·3	41·9	48·7	34·1	14·6	40·7	35·7	·210	2·4	0·5	83	549	81·3	31·6	0·4	4	10	2	15	1·8	5·8	15	1·64
HOLKHAM (Norfolk), John Davidson, Esq., Assistant to the Earl of Leicester.	39	Jan.	29·840	1·732	44·8	4·6	40·2	36·0	22·7	13·3	30·2	28·8	·145	1·8	0·2	86	564	47·7	17·3	0·9	7	6	13	5	—	6·7	16	1·00
		Feb.	29·759	1·528	50·5	24·2	26·3	41·3	30·9	10·4	36·2	33·0	·191	2·2	0·3	87	556	58·0	25·5	1·7	6	7	11	5	—	8·7	14	2·80
		Mar.	29·802	1·340	58·2	18·4	39·8	47·3	32·1	15·2	39·8	32·7	·187	2·2	0·7	76	553	94·7	25·0	1·8	7	6	8	10	—	5·5	9	1·87
LLANDUDNO (Carnarvonshire), James Nicol, Esq., M.D.	100	Jan.	29·779	1·840	48·2	14·5	33·7	39·0	29·4	9·6	34·3	28·7	·165	1·9	0·4	79	559	—	—	0·8	2	8	9	12	—	5·7	10	1·79
		Feb.	29·673	1·640	51·6	28·0	25·6	44·7	36·0	8·7	40·1	35·5	·208	2·4	0·4	84	550	—	—	1·1	3	9	8	8	—	6·7	15	3·05
		Mar.	29·732	1·450	56·0	28·0	28·0	47·5	37·7	9·8	42·4	36·6	·216	2·5	0·5	81	549	—	—	1·0	5	7	4	15	—	6·3	17	2·13
LIVERPOOL, The Observatory, John Hartnup, Esq., F.R.A.S.	197	Jan.	29·682	1·871	46·0	8·5	37·5	35·0	25·7	9·3	30·3	26·0	·141	1·6	0·4	82	562	—	—	0·9	5	12	9	5	—	6·5	11	1·11
		Feb.	29·572	1·606	51·0	28·6	22·4	42·2	34·6	7·6	37·7	34·4	·199	2·3	0·3	88	551	—	—	1·3	7	9	6	6	—	7·8	15	3·26
		Mar.	29·629	1·586	54·4	28·2	26·2	46·0	37·2	8·8	40·8	33·8	·211	2·5	0·4	82	549	—	—	1·6	3	7	7	14	—	7·0	20	2·89
BOLTON, Sharples (Lancashire), Rev. T. Mackereth, F.R.A.S., F.M.S.	481	Jan.	29·348	1·706	44·6	0·8	43·8	34·9	22·6	12·3	29·1	25·5	·138	1·7	0·2	86	557	—	—	0·7	8	7	10	6	2·4	6·8	11	1·25
		Feb.	29·231	1·763	49·5	23·9	25·6	40·0	31·2	8·8	35·7	32·7	·191	2·1	0·3	89	547	45·3	26·5	0·8	7	8	8	5	4·6	7·8	20	7·90
		Mar.	29·296	1·408	53·7	19·4	34·3	44·8	33·0	11·8	38·8	34·8	·204	2·4	0·3	85	545	51·5	27·8	1·2	6	5	7	13	7·2	7·6	20	6·23
HALIFAX, Bermerside Observatory (Yorkshire), E. J. Crossley, Esq., F.R.A.S.	530	Jan.	29·403	1·860	46·0	10·0	36·0	33·4	24·4	9·0	28·7	23·7	·124	1·5	0·3	79	559	47·4	22·0	0·3	6	12	3	10	—	7·8	10	0·38
		Feb.	29·303	1·596	50·0	22·0	28·0	38·9	30·4	8·5	34·6	32·4	·183	2·1	0·2	91	549	56·5	30·1	0·4	7	11	4	6	—	8·5	17	3·32
		Mar.	29·329	1·428	56·0	20·0	36·0	45·0	32·1	12·9	37·7	35·6	·209	2·4	0·2	91	546	75·1	31·7	0·8	4	7	7	13	—	6·6	19	3·84
HULL (Yorkshire), The People's Park, Mr. E. Peake.	12	Jan.	29·930	1·668	43·0	6·0	37·0	34·4	23·1	11·3	28·5	—	—	—	—	—	—	40·1	20·0	0·8	—	—	—	—	—	—	14	1·10
		Feb.	29·836	1·428	54·0	26·0	28·0	41·2	31·9	9·3	36·0	33·7	·195	2·2	0·3	90	558	50·6	30·6	1·2	8	7	6	7	—	7·5	22	3·14
		Mar.	29·847	1·250	58·0	17·0	41·0	45·7	32·3	13·4	39·7	34·4	·199	2·3	0·5	84	554	67·5	30·3	1·9	6	5	6	14	—	5·3	18	2·72
STONYHURST (Lancashire), Rev. S. J. Perry, F.R.S., F.M.S., F.R.A.S.	363	Jan.	29·508	1·800	47·2	4·6	42·6	36·4	22·6	13·8	29·2	23·1	·125	1·2	0·4	79	560	64·6	21·6	—	15	10	1	5	—	6·8	9	0·47
		Feb.	29·410	1·648	50·2	19·4	30·8	41·1	31·1	10·0	35·9	33·2	·190	2·1	0·3	90	550	69·1	29·3	—	7	8	7	6	—	8·2	14	6·32
		Mar.	29·446	1·405	55·9	18·4	37·5	46·3	33·2	13·1	39·0	35·6	·209	2·4	0·4	88	547	83·3	31·8	—	5	8	4	14	—	8·2	19	4·97
BRADFORD (Yorkshire), J. McLandsborough, Esq., C.E., F.G.S.	366	Jan.	29·484	1·834	46·5	12·0	34·5	34·8	25·9	8·9	30·5	26·3	·142	1·7	0·3	86	558	40·8	—	0·7	8	9	7	7	—	7·0	10	0·23
		Feb.	29·365	1·581	50·6	26·6	24·0	40·3	32·1	8·2	35·9	34·1	·196	2·3	0·2	93	549	49·9	—	0·7	7	8	7	6	—	8·1	20	4·05
		Mar.	29·446	1·468	53·6	21·4	32·2	45·2	34·8	10·4	39·3	36·8	·219	2·5	0·3	91	547	57·9	—	1·0	6	7	8	10	—	6·6	19	4·08
LEEDS (Yorkshire), The Philosophical Hall, Henry Crowther, Esq.	137	Jan.	29·795	1·886	48·0	12·0	36·0	36·2	26·5	9·7	31·9	28·0	·153	1·8	0·2	84	562	39·5	—	1·3	8	8	5	11	—	—	9	0·62
		Feb.	29·644	1·610	53·0	26·0	27·0	42·5	32·7	9·8	37·4	32·7	·185	2·1	0·4	83	555	49·2	—	1·6	8	9	5	6	—	4·6	15	3·09
		Mar.	29·702	1·456	59·0	22·0	37·0	47·6	34·2	13·4	40·4	36·5	·216	2·5	0·4	86	550	82·5	—	2·1	5	8	3	15	—	3·9	17	3·87
COCKERMOUTH (Cumberland), H. Donoson, Esq., M.D., F.M.S., F.R.A.S.	146	Jan.	29·749	1·836	47·0	4·4	42·6	34·2	22·2	12·0	27·7	22·7	·122	1·7	0·2	81	566	40·1	18·1	0·2	6	17	4	4	0·5	5·2	9	0·75
		Feb.	29·628	1·706	52·0	19·5	32·5	42·4	32·5	9·9	37·1	33·6	·192	2·2	0·4	87	553	61·6	29·8	0·4	6	14	7	1	1·5	8·1	18	3·24
		Mar.	29·666	1·432	58·0	18·2	39·8	46·5	34·5	12·0	40·0	35·6	·209	2·4	0·5	84	550	75·8	31·8	0·7	7	7	7	10	2·5	7·5	19	3·93

Meteorological Table, Quarter ending Mar

Names of Stations and Observers.	Height of Station above Sea Level.	Year last. Months.	Pressure of Atmosphere in Month. Mean.	Range.	Temperature of Air in Month. Highest.	Lowest.	Range.	Mean of all Highest.	Mean of all Lowest.	Mean Daily Range.	Mean Temperature. Air.	Dew Point.	Vapour. Elastic Force.	In a cubic foot of Air. Mean.	Short Saturation.	Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer. Maximum in Rays of Sun.	Minimum on Grass.	Estimated Strength.	Wind. Relative Proportion of E.	S.	W.	N.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	grs.		grs.	°	°									in.
SILLOTH (Cumberland), "The Rectory," Rev. F. Redford, M.A., F.R.A.S., F.M.S.	98	Jan.	29·884	1·601	48·5	1	46·5	33·2	21·1	12·1	37·9	19·3	·101	1·79	0·4	71	369	61·1	15·5	0·8	15	2	6	6	4·4	4·0	4	0·46
		Feb.	29·772	1·749	50·5	29·7	20·8	41·5	29·2	11·3	38·6	18·0	·100	1·72	0·4	88	366	66·5	20·2	1·3	12	3	9	4	6·1	7·2	16	3·31
		Mar.	29·790	1·402	53·0	29·5	24·5	44·8	32·9	11·9	39·0	24·2	·107	2·13	0·4	86	355	80·9	25·3	1·6	9	3	16	1	6·5	6·4	20	3·18
CARLISLE, Spital (Cumberland), Isaac Cartmell, Esq., F.M.S.	114	Jan.	29·788	1·693	47·3	3·5	43·8	32·8	17·4	15·4	35·9	18·5	·119	1·73	0·3	85	369	48·4	10·5	0·8	13	3	11	3	1·3	8·1	5	0·20
		Feb.	29·666	1·736	51·3	19·8	31·5	42·1	21·4	10·7	36·4	24·0	·137	2·03	0·3	91	354	60·7	24·8	1·4	3	15	9	3	5·6	8·0	12	2·85
		Mar.	29·675	1·590	54·8	15·8	39·0	46·2	31·6	14·6	39·2	25·4	·208	2·94	0·4	87	351	71·4	25·3	1·6	9	3	19	1	4·6	7·6	11	2·27
BYWELL (Northumberland), Mr. W. J. Tose, Assistant to W. H. Beaumont, Esq., M.P.	87	Jan.	29·720	1·164	48·0	7·0	41·0	31·5	22·6	8·9	36·8	22·8	·122	1·73	0·2	79	367	62·8	19·8	1·0	3	1	20	3	4·4	8·9	9	1·04
		Feb.	29·597	1·091	50·0	29·0	21·0	40·2	22·6	7·6	35·5	21·9	·180	2·61	0·3	87	354	57·4	21·2	1·2	4	1	17	6	5·1	9·0	10	2·51
		Mar.	29·745	1·201	50·0	29·0	21·0	44·8	29·4	15·4	39·7	24·1	·187	2·70	0·4	80	355	64·1	24·6	1·1	5	3	12	1	5·1	7·9	8	1·98
NORTH SHIELDS (Northumberland), Robert Spence, Esq.	126	Jan.	29·852	1·207	46·0	6·0	40·0	31·0	22·0	9·0	36·9	23·9	·143	1·78	0·1	80	366	64·5	21·3	1·3	10	6	11	4	5·6	8·6	15	1·65
		Feb.	29·730	1·066	51·0	21·0	30·0	42·0	29·0	13·0	36·0	24·0	·196	2·75	0·1	86	355	64·7	24·4	1·4	9	3	15	3	5·5	7·5	13	2·61
		Mar.	29·731	1·432	55·0	19·2	35·8	45·3	32·7	12·6	37·1	25·2	·205	2·94	0·3	83	355	73·3	32·3	1·9	11	3	19	2	5·5	6·3	19	2·92

Second Rain-gauges are placed—
At Beachey Head, at the height of 515 feet *above the sea*; the amount collected was 0·05 inches.
" Stratfield Turgis, " 485 " " *ground*,
" Oxford, " 284 " "
" Carlington, " 236 " "
" Northam, " 80 " "
" Bickham, " 4 " "

January. 0·84 inches. 0·84 " 0·64 " 0·84 "

February. 2·46 inches. 2·37 " 1·61 " 1·72 " 2·13 " 1·02 "

March. 2·72 inches. 2·83 " 1·60 " 1·51 " 1·78 " 1·02 "

Total in Quarter. 5·83 inches. 6·04 " 4·00 " 4·36 " 5·16 " 2·92 "

NGLAND,

30, 1881.

DING JUNE 30TH, 1881.

il of March, continued till the
Wind then changed to the S.W.,
weather was very cold at the
il moderately cold afterwards.

with a cloudy sky; then there
on the 10th and 11th the
ng below 32°, and at some as
reat deal of damage was done
der of the month the weather
alternately to the end of the
at the end. The month was

he wind from the S.W.; the
middle of the month. The
or all agricultural operations.
so miles N.N.E. of Guernsey,

ge till April 9th, the daily
arm, the average daily excess
very variable, being for a few
e average, the latter, however,
he 34 days ending May 22nd,
rm weather, the average daily
was a period of equally cold
the temperature was 1°·8 in
e average daily deficiency of

·2 and 1°·2 below the average
April 1880, but 2°·7 higher

6 and 1°·5 above the average
in May 1880, and 5°·7 higher

·5 above the average of 110
than in June 1880, and 1°·8

ove the average of 110 years,

being 2° below the average of
in June it was 70°, being 1°

being 1°·7 below its average
nd in June it was 49°·7, being
w in April and June, and high
ry nearly their average values

average in May, and was 0°·3

March by 3°·3; in May higher

erature from March to April is

tations south of 51° was 2°·3;

f latitude 52°, and was 8°·8 at

and was 3°·5.

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1881.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat°. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a cubic foot of Air.						Relative Proportion of								
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.			Maximum in Rays of Sun.	Minimum on Grass.	Estimated Strength.	N.	E.	S.	W.			Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	grs.		grs.	°	°								in.
SOMERLEYTON (Suffolk), The Rectory, Rev. C. J. Steward, F.M.S.	50	Jan.	29·842	1·748	48·0	4·8	43·2	34·0	25·1	8·9	37·3	28·0	·153	1·8	0·1	90	565	—	—	1·0	10	7	6	8	5·6	8·2	18	1·39
		Feb.	29·760	1·464	47·8	24·0	23·8	41·0	32·6	8·4	36·4	34·1	·198	2·2	0·3	92	556	—	—	1·0	7	8	7	6	7·5	7·3	20	2·75
		Mar.	29·824	1·302	60·5	22·0	38·5	48·6	34·9	13·7	40·6	37·9	·227	2·6	0·3	90	552	—	—	1·0	5	7	5	14	7·1	4·8	12	1·75
WOLVERHAMPTON (Staffordshire), Wrottesley,	500	Jan.	29·285	1·724	45·6	4·3	41·3	31·4	21·3	12·1	27·4	24·3	·131	1·6	0·2	87	558	—	—	—	8	9	7	9	—	7·7	8	0·43
		Feb.	29·259	1·324	49·8	21·5	28·3	41·1	31·1	10·0	36·5	34·2	·203	2·3	0·2	93	546	—	—	—	6	10	7	5	—	8·4	15	2·22

The mean daily range of temperature was 0°·8 and 2°·2 less than the average in January and February respectively, and it was 1° greater in March.

Thunderstorms occurred on January 12th at North Shields; on February 7th at Guernsey, and in Cornwall and Devonshire; and on February 10th at Guernsey, in Devonshire, and in the midland counties.

Thunder was heard but lightning was not seen on February 7th at Torquay; on the 10th at Carlisle; on the 19th at Stockton; on the 27th at North Shields; and on March 21st at Liverpool.

Lightning was seen but thunder was not heard in Devonshire on February 7th and 8th.

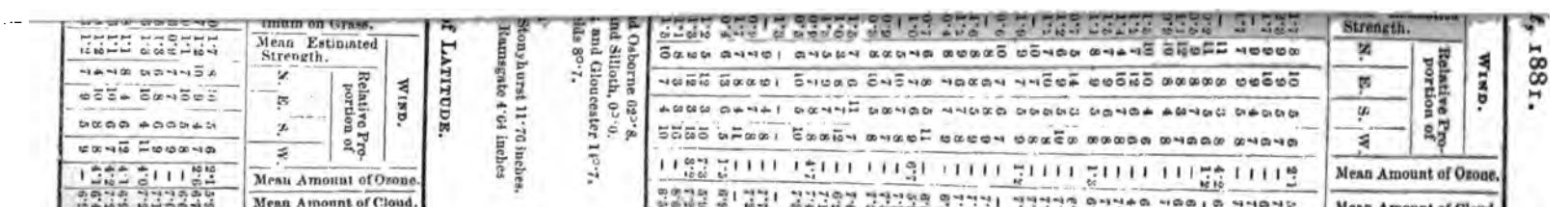
Solar halos were seen on January 17th and 18th; on February 1st, 3rd, 12th, and 28th; on March 2nd, 8th, 23rd, and 29th.

Lunar halos were seen on four nights in January; on five in February; and on seven in March.

Aurora Borealis was generally seen on January 31st; and at Silloth on March 19th and 20th.

Hail fell on seven days in January; on 12 in February; and on 12 in March.

Fog was very general on 18 days in January; on 16 days in February; and on 19 days in March; in both February and March it was most prevalent north of 52°.



METEOROLOGY OF ENGLAND,

DURING THE QUARTER ENDING JUNE 30, 1881.

Remarks on the Weather during the Quarter ending June 30th, 1881.

By James Glaisher, Esq., F.R.S., *&c.*

The cold east and north-east winds which set in towards the end of March, continued till the 10th of April, the sky being generally clear; the direction of the wind then changed to the S.W., but came back again on the 17th to a compound of the east. The weather was very cold at the beginning of the month; it was warm from the 10th to the 18th, and moderately cold afterwards. The fall of rain in the month was small.

The weather in May was cold at the beginning of the month, with a cloudy sky; then there were a few warm days, succeeded by some very cold weather; on the 10th and 11th the temperature was everywhere low, the minimum at many places being below 32°, and at some as low as 22° and 23°; the thermometer on grass was still lower. A great deal of damage was done to many crops, by the severity of this May frost. During the remainder of the month the weather was for a few days warm, and then for a few days cold, and so alternately to the end of the month. Some warm rain fell in the middle of the month, and again at the end. The month was most favourable for agricultural work.

The weather during the first few days in June was warm, with the wind from the S.W.; the wind then changed to the N. and N.W., and continued so till the middle of the month. The remainder of the month was changeable, but was very favourable for all agricultural operations. On the 12th of June at 8 p.m. the Island of Alderney, which is 20 miles N.N.E. of Guernsey, was seen from there for 20 minutes as a mirage.

The mean daily temperature of the air was below the average till April 9th, the daily deficiency being $3\frac{1}{2}$°; from the 10th to the 18th the weather was warm, the average daily excess being 4°·7; from April 19th to May 22nd, the temperature was very variable, being for a few days together above the average, and then for a few days below the average, the latter, however, preponderating; the average deficiency of daily temperature for the 34 days ending May 22nd, was 1°·6; from May 23rd to June 4th there was a period of warm weather, the average daily excess of these 13 days being 5°·3; from June 5th to 14th there was a period of equally cold weather, the average daily deficiency being 5°·3; then for four days the temperature was 1°·8 in excess daily, and from June 19th to the end of the quarter the average daily deficiency of temperature was 1°·1.

The mean temperature of the air for April was 45°·9, being 0°·2 and 1°·2 below the average of 110 years and 40 years respectively; it was 1°·2 lower than in April 1880, but 2°·7 higher than in April 1879.

The mean temperature of the air for May was 54°·1, being 1°·6 and 1°·5 above the average of 110 years, and 40 years respectively; it was 1°·5 higher than in May 1880, and 5°·7 higher than in May 1879.

The mean temperature of the air for June was 58°·7, being 0°·5 above the average of 110 years, but 0°·2 below that of the 40 years; it was 1°·2 higher than in June 1880, and 1°·8 higher than in June 1879.

The mean temperature for the quarter was 52°·9, being 0°·6 above the average of 110 years, but the same as the average of the preceding 40 years.

The mean high day temperature of the air in April was 55°·6, being 2° below the average of 40 years; in May it was 65°·8, being 1°·6 above the average, and in June it was 70°, being 1° below the average.

The mean low night temperature of the air was in April 37°·5, being 1°·7 below its average in May it was 43°·6, being very nearly the same as the average, and in June it was 49°·7, being 0°·2 below the average, therefore the high day temperature was low in April and June, and high in May; the low night temperatures were low in April, but of very nearly their average values in May and June.

The mean daily range of temperature was 2°·1 greater than the average in May, and was 0°·3 and 0°·7 smaller than the average in April and June.

The mean temperature of the air in April was higher than in March by 3°·3; in May higher than in April by 8°·2, and in June higher than in May by 4°·6.

(From the preceding 40 years observations the increase of temperature from March to April is 5°·4; from April to May is 5°·5, and from May to June is 6°·3).

The mean increase of temperature from March to April from all stations south of 51° was 2°·3; and from stations north of 51° was 3°·3.

From April to May the increase was 7°·5 at stations south of latitude 52°, and was 8°·8 at stations north of this parallel.

From May to June the increase was nearly the same everywhere, and was 3°·5.

Near London the mean daily pressure of the atmosphere till April 6th was below the average by 0·057 in.; from the 7th to the 10th it was above by 0·116 in.; then for four days it was below by 0·070 in. daily; for five days above by 0·037 in.; from the 20th to the 22nd below by 0·148 in., and from the 23rd to the 29th above by 0·101 in. April 28th was the only day in the month on which the mean pressure reached 30 ins.

On the first two days of May the barometer reading was low, from the 3rd to the 14th it was high, the reading being constantly above 30 ins. from the 5th to the 12th; on the 10th it was as high as 30·458 ins. or 0·717 in. above the average, this was the day of low temperature and frost. The average excess of daily pressure to the 12th of May was 0·402 ins.; from the 15th to the 19th there was an average defect of 0·216 in.; from 20th to 24th an excess of 0·272 in.; and a defect of 0·112 in. till the 28th. From May 29th to June 3rd the pressure was above the average by 0·212 in. daily; from June 4th to 7th it was low, being 0·335 in. daily in defect of the average; to the 14th the pressure was a little above the average; from June 15th to 22nd it was 0·116 in. below, and from June 23rd to the end of the month it was high, being 0·147 in. above the average.

1881. Months.	Temperature of Air. Mean.	Air. Diff. from average of 110 years.	Air. Diff. from average of 40 years.	Temperature of Evaporation. Mean.	Evaporation. Diff. from average of 40 years.	Dew Point. Mean.	Dew Point. Diff. from average of 40 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 40 years.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 40 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour in a Cubic Foot of Air. Diff. from average of 40 years.
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	gr.
April -	45·9	−0·2	−1·2	42·2	−1·8	37·9	−2·6	18·1	−0·3	·220	−0·023	2·6	−0·2
May -	54·1	+1·6	+1·5	49·4	+0·6	44·7	−0·3	22·5	+2·1	·296	−0·002	3·4	0·0
June -	58·7	+0·5	−0·2	53·9	−0·7	49·6	−1·1	20·3	−0·7	·356	−0·015	4·0	−0·1
Means -	52·9	+0·6	0·0	48·5	−0·6	44·1	−1·3	20·3	+0·4	·294	−0·013	3·3	−0·1

1881. Months.	Degree of Humidity. Mean.	Degree of Humidity. Diff. from average of 40 years.	Reading of Barometer. Mean.	Reading of Barometer. Diff. from average of 40 years.	Weight of a Cubic Foot of Air. Mean.	Weight of a Cubic Foot of Air. Diff. from average of 40 years.	Rain. Amount.	Rain. Diff. from average of 56 years.	Daily Horizontal movement of the Air.	Reading of Thermometer on Grass. Number of Nights it was At or below 30°.	Between 30° and 40°.	Above 40°.	Lowest Reading at Night.	Highest Reading at Night.
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
April -	74	− 5	29·772	+0·016	546	+ 3	0·62	−1·04	357	14	10	6	24·3	43·1
May -	71	− 5	29·929	+0·143	540	− 1	1·62	−0·46	284	6	14	11	21·9	55·2
June -	72	− 2	29·806	0·000	532	0	1·86	−0·14	230	0	5	23	33·1	54·0
Means -	72	− 4	29·836	+0·053	539	+ 1	Sum 4·10	Sum −1·64	Mean 291	Sum 20	Sum 33	Sum 39	Lowest 21·9	Highest 55·2

NOTE.—In reading this table it will be borne in mind that the plus sign (+) signifies *above* the average, and that the minus sign (−) signifies *below* the average.

The average duration of the different directions of the wind referred to eight points of the compass, and the duration of each direction in each month in the quarter, were as follow:—

Direction of Wind.	April. 1881.	April. Average.	April. Departure from Average.	May. 1881.	May. Average.	May. Departure from Average.	June. 1881.	June. Average.	June. Departure from Average.
	d.	d.	d.	d.	d.	d.	d.	d.	d.
N.W.	3	2¼	+ ¾	2	1½	+ ½	2	2	0
N.	3	4	−1	6	4½	+1½	4	3½	− ½
N.E.	10	6	+4	6	7	−1	1	3½	−2½
E.	5	3½	+1½	3	2½	+ ½	2	2	0
S.E.	1	2	−1	0	1½	−1½	3	1½	−1½
S.	1	2½	−1½	1	2½	−1½	5	2	+3
S.W.	4	6½	−2½	10	7½	+2½	7	10	−3
W.	3	2½	+ ½	3	2	+1	6	3½	+2½

The sign (+) denotes excesses over averages; in April the largest number with a (+) sign is that opposite to N.E., in May opposite to S.W., and in June opposite to S.

The sign (−) denotes deficiences below averages. In April the largest number is opposite to S.W., in May to S.E. and S., and in June to S.W.

The mean reading of the barometer for the month of April was 29·772 ins. being 0·016 in. above the average of 40 years, and 0·071 in. above that of 1880, and 0·252 in. above that of 1879.

The mean reading for the month of May was 29·929 ins., being 0·143 in. above the average of 40 years, and 0·019 in. above that of 1880, and 0·096 in. above that of 1879.

The mean reading for the month of June was 29·806 ins. being the same as the average of 40 years, and 0·073 in. above that of 1880, and 0·165 in. above that of 1879.

The atmospheric pressure in April was 0·044 in. greater than in March; that in May was 0·155 in. greater than in April, and that of June was 0·123 in. less than in May. (From the 40 years' observations the mean pressure in April is 0·008 in. greater than in March; that in May 0·030 in. greater than in April, and that in June 0·020 greater than in May).

At all stations excepting Guernsey there was an increase of atmospheric pressure from March to April at stations South of latitude 51° of 0·01 in.; at those between latitudes 51° and 52° of 0·05 in.; between 52° and 53° of 0·07 in.; between 53° and 54° of 0·12 in., and North of 54° of 0·17 in.

From April to May there was a further increase at stations South of 51° amounting to 0·196 in.; between 51° and 52° to 0·158 in.; in the next degree to 0·131 in., and north of 53° to 0·075 in.

From May to June there was a decrease everywhere and nearly to the same amount, viz.; 0·126 in.

The fall of rain at Greenwich in April was 0·62 in., being 1·04 in. below the average of 65 years; the fall in May was 1·62 in., being 0·46 in. below the average, and in June it was 1·86 in. being 0·14 in. below the average. The fall in the quarter was 4·1 ins. being 1·64 in. below the average. The fall of rain in April was less than in 1880 by 1·6 in. and less than in 1879 by 2·0 ins.; the fall in May was less than in 1880 by 1·1 in., and less than in 1879 by 2·8 ins.; the fall in June was less than in 1880 by 0·4 in., and less than in 1879 by 2·4 ins.

Thunderstorms occurred in April on the 14th at Cardington; on the 16th at Bolton and Stonyhurst, and on the 26th at many places extending from latitude 50°½ to 54°. In May, on the 4th at Royston, Cardington, and Cambridge; on the 19th at Bath, Wrottesley, and Stonyhurst; on the 25th at Silloth; on the 26th between latitudes 52° and 54°; on the 27th at Stonyhurst; on the 28th at stations south of latitude 52°, and on the 31st at Silloth. In June, on the 2nd at Salisbury and Cambridge; on the 3rd at Bolton; on the 6th at Strathfield Turgiss, Whitchurch, Cambridge, and Carlisle; on the 7th at Cardington; on the 15th and 18th at Carlisle, and on the 19th, 21st, and 22nd at Stonyhurst.

Thunder was heard but lightning was not seen in April, on the 10th and 13th at Silloth; on the 14th at Wrottesley; on the 25th at Lowestoft; on the 26th at Salisbury, Marlborough, and Lowestoft, and on the 27th at Wrottesley. In May on the 4th at Stockton near Rugby; on the 5th at Cambridge; on the 20th at Bermerside; on the 25th at Liverpool and Silloth; on the 26th at Oxford, Gloucester, Stockton, Liverpool, and Silloth; on the 27th at Bermerside; on the 28th at Ventnor, Bath, Royston, Stockton, and Silloth, and on the 29th at Silloth. In June, on the 2nd at Strathfield Turgiss, Oxford, and Gloucester; on the 3rd at Strathfield Turgiss, and Oxford; on the 4th at Silloth; on the 5th at Oxford and Bermerside; on the 6th at Osborne, Gloucester, Cardington, Wrottesley, and Silloth; on the 8th at Babbacombe, Wrottesley, and Carlisle; on the 14th at Hull; on the 15th and 16th at Ventnor; on the 20th at Liverpool; on the 22nd at Oxford and Wrottesley, and on the 28th at Oxford.

Lightning was seen but thunder was not heard in May on the 5th at Oxford; on the 23rd at Truro; on the 25th at Oxford and Norwich; on the 26th at Liverpool, Halifax, and Hull. On the 6th of June at Guernsey; and on the 19th at Liverpool.

Solar halos were seen in April on 8 days, in May on 7 days, and in June on 3 days.

Lunar halos were seen on 5 nights in April; and on 2 in May.

Aurora Borealis was seen on April 20th at Cambridge, Llandudno, and Stonyhurst.

Snow fell in April on the 5th at Marlborough; on the 19th it fell generally between latitude 51° and 54°; on the 20th there were large flakes of snow at Guernsey and snow fell generally over the country in small quantities, and on the 21st it fell at Bath, Barnet, Royston, Lowestoft, Cambridge, Llandudno, Hull, and Bradford.

Hail fell in April on the 11th, 16th, 17th, 19th, 20th, 21st, 23rd, 25th, 26th, and 28th at different stations; in May on the 1st, 3rd, 4th, 19th, 20th, and 26th, and in June on the 6th, 7th, 8th, 9th, and 22nd.

Fog prevailed on 8 days in April, on 13 days in May, and on 12 days in June.

MONTHLY METEOROLOGICAL TABLE FOR THE QUARTER ENDING JUNE 30TH, 1881.

The Observations have been reduced to Mean values by Glaisher's Barometrical and Diurnal Range Tables, and the Hygrometrical results have been deduced from the sixth edition of his Hygrometrical Tables.

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1881. Months.	Pressure of Atmosphere in Month. Mean.	Pressure of Atmosphere in Month. Range.	Temperature of Air in Month. Highest.	Lowest.	Range.	Mean Highest.	Mean Lowest.	Mean Daily Range.	Mean Temperature. Air.	Dew Point.	Vapour. Elastic Force.	Vapour. In a cubic foot of Air. Mean.	Saturation.	Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer. Maximum in Rays of Sun.	Minimum on Grass.	Wind. Estimated Strength.	Relative Proportion of N.	E.	S.	W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									
GUERNSEY, Adolphus Collenette, Esq., F.M.S.	270	April	29·602	0·751	63·0	36·0	27·0	51·6	43·0	8·6	46·4	41·3	·290	3·2	0·4	89	542	92·6	30·4	1·4	5	10	5	7	5·7	5·6	10	1·00
		May	29·841	1·067	67·0	39·5	27·5	58·8	46·7	12·1	51·3	47·2	·327	3·6	0·6	89	540	105·1	40·9	1·3	7	7	7	10	4·2	5·9	12	1·66
		June	29·737	0·772	75·0	41·0	34·0	62·6	51·0	12·6	54·6	49·2	·351	3·9	1·0	80	534	111·8	47·0	1·2	8	4	7	11	4·6	4·1	14	1·37
TRURO (Cornwall), C. Barham, Esq., M.D., F.M.S.	43	April	29·855	0·620	65·0	30·0	35·0	55·4	42·1	13·3	44·6	42·1	·269	3·1	0·4	86	545	—	—	2·7	6	13	5	6	—	7·1	11	1·36
		May	30·046	1·048	77·0	35·0	42·0	64·0	45·9	18·1	53·8	45·7	·306	3·5	1·0	74	542	—	—	2·7	8	6	6	11	—	4·9	8	0·72
		June	29·913	0·857	81·0	37·0	44·0	65·8	50·8	15·0	55·5	49·3	·351	4·0	1·0	80	537	—	—	2·7	11	1	8	10	—	6·2	15	3·29
PLYMOUTH (Devon), J. Merrifield, Esq., LL.D., F.R.A.S., F.M.S.	69	April	29·910	0·682	65·1	31·1	34·0	54·5	41·5	13·0	46·4	38·5	·254	2·7	0·9	75	546	—	—	1·7	5	14	5	6	—	7·6	9	0·96
		May	30·129	1·067	72·7	37·7	35·0	61·4	47·6	13·7	53·7	45·6	·307	3·4	1·0	74	544	—	—	1·6	6	7	8	9	—	4·7	12	1·29
		June	29·996	0·835	79·0	40·0	39·0	64·8	51·0	13·8	56·6	50·3	·362	4·1	0·9	79	537	—	—	1·5	9	3	9	9	—	6·1	13	3·59
TOTNES (Devon), T. H. Edmonds, Esq.	107	April	29·932	0·578	66·1	27·4	38·7	55·7	39·6	16·1	47·0	38·5	·253	2·7	1·0	73	547	108·3	34·3	3·1	10	12	3	5	—	6·8	11	0·85
		May	30·130	1·063	76·2	34·4	41·8	63·4	43·0	20·4	53·2	44·0	·288	3·2	1·3	71	544	121·0	36·6	1·5	5	10	6	10	—	4·1	10	1·28
		June	29·970	0·847	80·5	34·8	45·7	65·8	48·0	17·8	56·0	48·2	·310	3·8	1·2	75	538	120·5	42·6	1·1	6	2	10	12	—	6·3	18	3·47
TORQUAY, Babbacombe (Devon), Edwin E. Glyde, Esq., F.M.S.	305	April	29·588	0·651	69·9	30·8	39·1	52·1	40·3	11·8	43·5	38·2	·231	2·7	0·8	76	548	122·7	33·8	1·8	8	12	4	6	5·0	7·5	9	0·79
		May	29·799	1·056	73·7	33·8	39·9	61·8	45·8	16·0	52·6	44·8	·297	3·4	1·1	75	548	134·0	35·7	1·3	8	7	8	10	5·0	4·1	9	0·66
		June	29·672	0·838	77·8	39·2	37·9	68·2	49·6	13·7	55·0	47·6	·330	3·8	1·1	76	536	150·4	42·3	1·2	7	4	10	9	5·3	6·7	18	3·16
VENTNOR, (Isle of Wight) (Royal National Hospital for Consumption), J. Codling, Esq.	150	April	29·802	0·497	62·8	29·5	33·3	53·5	40·4	13·1	45·2	39·2	·239	2·8	0·7	79	547	—	—	—	11	12	1	6	4·0	7·9	10	1·15
		May	30·010	1·046	74·5	38·0	36·5	60·9	46·7	14·2	52·2	43·9	·310	3·5	0·9	80	543	—	—	—	7	9	5	10	5·0	4·0	10	1·24
		June	29·902	0·832	74·7	39·1	35·6	64·4	51·1	13·3	55·7	50·7	·361	4·1	0·8	84	537	—	—	—	3	1	12	11	5·0	6·2	12	1·99
EASTBOURNE (Sussex), Miss W. L. Hall.	12	April	29·877	0·498	66·2	29·0	37·2	54·2	38·7	15·5	46·0	39·6	·244	2·8	0·8	79	547	103·4	28·3	0·4	5	14	5	6	—	—	8	0·58
		May	30·040	1·015	75·4	29·5	45·9	63·8	44·3	19·5	53·3	46·9	·321	3·6	1·0	81	542	111·0	32·6	0·4	6	10	3	12	—	—	12	1·31
		June	29·931	0·526	76·5	38·5	38·0	62·2	46·4	15·8	51·4	53·4	·409	4·6	0·7	87	535	123·9	36·1	0·3	4	5	7	14	—	—	10	2·27
OSBORNE (Isle of Wight), J. R. Mann, Esq.	172	April	29·745	0·628	65·0	31·0	34·0	55·6	38·8	16·8	45·5	39·7	·245	2·8	0·6	80	546	109·1	34·7	0·6	9	10	5	6	—	6·6	5	0·70
		May	29·931	1·028	79·1	35·0	44·1	64·9	44·8	20·1	54·7	46·9	·330	3·6	1·2	74	538	129·1	40·6	0·6	6	6	9	10	—	4·6	9	1·48
		June	29·821	0·600	83·0	40·1	42·9	68·7	50·1	18·6	57·2	53·8	·414	4·6	0·7	88	533	120·9	46·8	0·2	6	3	12	9	—	6·3	11	1·70
BRIGHTON (Sussex), F. E. Sawyer, Esq., F.M.S.	206	April	29·721	0·650	64·0	27·0	37·0	53·1	38·2	14·9	45·2	35·5	·215	2·4	1·0	70	546	91·6	35·9	1·5	9	10	6	5	—	6·9	8	0·45
		May	29·895	1·032	72·5	33·7	38·8	61·6	45·4	16·2	53·1	43·7	·285	3·2	1·3	71	540	103·7	42·3	1·0	8	7	8	8	—	5·4	9	0·86
		June	29·735	0·858	75·0	36·6	38·4	66·2	50·6	15·6	57·5	48·9	·350	3·8	1·5	72	533	110·6	47·8	0·7	5	4	12	9	—	6·6	11	3·19
SALISBURY (Wilton House), Wilts, Thomas Challis, Esq.	186	April	29·741	0·578	70·0	28·5	53·5	60·7	35·3	25·4	47·1	41·4	·261	3·0	0·7	82	543	100·1	32·8	1·5	7	12	5	7	—	6·7	8	0·56
		May	29·905	1·082	82·0	23·0	57·0	68·5	39·4	29·1	53·3	45·7	·308	3·5	1·1	75	541	134·6	37·3	1·4	8	7	6	10	—	4·1	8	1·11
		June	29·782	0·820	86·5	31·5	55·0	70·2	45·7	24·5	56·3	49·9	·361	4·0	1·0	83	534	115·1	43·8	1·2	9	4	7	10	—	—	14	1·91
BARNSTAPLE (Devon), William Knill, Esq.	43	April	29·575	0·640	69·0	31·5	37·5	57·5	42·9	14·6	49·6	41·5	·282	3·0	0·9	76	544	—	—	1·4	7	9	7	7	—	2·5	9	1·50
		May	29·948	1·139	82·0	41·0	41·0	66·1	49·4	16·7	56·2	49·2	·332	4·0	1·1	78	540	—	—	1·2	5	4	9	13	—	2·3	7	2·05
		June	29·927	0·890	83·0	38·0	44·0	69·1	53·4	14·7	58·5	51·7	·383	4·3	1·2	78	531	—	—	1·2	4	2	11	13	—	4·2	17	3·40
RAMSGATE (Kent), Rev. T. E. Egan, O.S.B.	108	April	29·843	0·609	60·1	33·0	27·1	51·1	40·1	11·0	44·6	39·3	·241	2·7	0·6	82	548	—	—	1·6	5	15	6	8	—	7·0	16	0·98
		May	29·998	1·150	70·2	32·3	37·9	59·8	45·6	13·7	51·5	46·6	·320	3·7	0·8	83	543	—	—	1·2	6	10	8	7	—	5·4	14	1·69
		June	29·902	0·939	76·8	39·1	37·7	65·4	50·3	15·1	56·3	50·3	·366	4·1	0·9	80	536	—	—	1·1	4	11	8	7	—	5·7	12	2·70

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1881.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a Cubic foot of Air.						Relative Proportion of							
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.			Maximum in Rays of Sun.	Minimum on Grass.	Estimated Strength.	N.	E.	S.	W.			Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								in.
CATERHAM (Surrey), Metropolitan Asylum, G. Stanley Elliot, Esq., M.D.	607	April	29·269	0·690	64·2	25·5	38·7	52·7	36·7	16·0	45·1	36·7	·217	2·5	0·9	72	537	—	—	1·5	7	12	6	5	—	—	5	0·68
		May	29·442	1·100	68·0	29·6	39·0	63·1	41·8	21·3	52·9	50·3	·365	4·1	0·5	92	531	—	—	1·6	8	11	3	9	—	—	10	1·10
		June	29·390	0·900	77·0	26·0	51·0	68·8	47·3	19·5	56·1	50·9	·374	4·2	0·8	82	527	—	—	1·6	7	8	9	11	—	—	8	2·09
STRATHFIELD TURGISS (Hants), Rev. C. H. Griffith, M.A., F.M.S.	197	April	29·727	0·383	66·2	36·2	30·0	57·1	36·2	20·9	45·6	37·0	·221	2·5	1·0	73	545	105·5	30·3	1·3	6	13	3	10	2·2	5·6	8	0·84
		May	29·869	1·131	79·8	35·7	32·1	68·3	41·1	25·2	53·5	48·3	·338	3·8	0·8	82	530	114·6	33·2	1·2	7	11	4	9	2·6	4·4	12	0·72
		June	29·784	0·830	81·7	35·5	46·4	68·0	47·9	20·1	56·9	47·9	·334	3·8	1·2	72	533	118·9	42·7	1·1	5	4	10	11	2·6	6·3	12	1·99
BATH (Somerset), St. Gregory's College, Downside, Rev. T. J. Almond, O.S.B., F.M.S.	536	April	29·525	0·502	64·0	24·5	39·7	55·8	36·7	17·1	43·8	39·4	·245	2·8	0·5	84	540	105·1	34·0	1·6	10	9	5	8	—	6·3	10	0·94
		May	29·447	1·120	75·0	29·5	45·5	61·4	43·1	18·3	51·5	43·1	·280	3·2	1·1	74	533	112·2	39·3	1·3	7	5	5	14	—	5·4	15	3·25
		June	29·334	0·827	75·3	36·5	38·8	62·1	48·5	13·6	53·9	47·8	·328	3·8	0·9	80	528	112·0	46·4	1·5	6	2	10	12	—	6·8	13	3·36
MARLBOROUGH (Wilts), Rev. Thomas A. Preston, M.A., F.M.S.	456	April	29·430	0·576	62·9	26·2	36·7	54·4	36·4	18·0	44·1	36·3	·214	2·5	0·8	73	541	105·2	31·5	1·1	5	15	2	8	—	6·0	10	0·87
		May	29·397	1·128	75·5	28·1	47·4	63·0	42·5	20·5	52·0	42·5	·272	3·1	1·3	71	536	115·7	34·9	0·7	7	7	3	14	—	4·6	9	1·50
		June	29·464	0·822	78·2	35·1	43·1	64·5	47·9	16·6	55·2	47·4	·328	3·7	1·2	75	529	115·7	42·6	0·9	7	2	9	12	—	6·3	15	2·29
BLACKHEATH (Kent), James Glaisher, Esq., F.R.S.	160	April	29·761	0·389	67·6	29·5	38·1	55·4	38·5	16·9	45·4	39·3	·242	2·8	0·7	79	546	105·8	35·0	1·1	10	10	5	5	—	6·6	8	0·49
		May	29·631	1·104	76·2	34·0	42·2	64·6	45·6	19·0	53·7	45·4	·302	3·4	1·2	73	540	111·9	39·9	1·2	11	6	5	9	—	5·6	11	1·56
		June	29·804	0·911	81·6	39·7	41·9	69·1	51·1	18·0	58·1	50·3	·366	4·1	1·3	76	532	127·6	47·3	1·0	6	4	10	10	—	6·8	10	2·61
WHITCHURCH RECTORY (Oxon), (near Reading). Rev. J. Slatter, M.A., F.R.S., F.M.S.	150	April	29·781	0·484	65·0	26·2	39·7	56·2	37·1	19·1	46·0	38·5	·231	2·7	0·9	75	546	—	—	1·4	7	12	4	7	—	5·1	7	0·63
		May	29·914	1·149	77·2	30·2	47·0	66·1	42·1	24·0	54·9	44·6	·295	3·5	1·3	70	539	—	—	1·3	6	9	6	10	—	4·5	15	1·40
		June	29·826	0·814	80·4	35·9	44·5	69·8	46·8	23·0	57·7	50·5	·362	4·1	1·2	76	533	—	—	1·3	4	4	10	12	—	5·9	—	—
CAMDEN SQUARE (London), G. J. Symons, Esq., F.R.S., F.M.S.	123	April	29·814	0·612	67·8	27·8	40·0	56·9	38·2	18·7	46·3	41·8	·265	3·0	0·6	85	546	103·0	33·6	—	14	10	1	5	—	6·5	9	0·46
		May	29·859	1·179	80·7	31·2	49·5	66·7	44·9	21·8	54·6	45·0	·288	3·3	1·5	70	540	112·5	40·1	—	10	7	5	9	—	4·6	11	1·52
		June	29·843	0·858	82·7	36·4	45·3	70·6	50·4	20·2	59·0	47·3	·324	3·6	2·1	64	532	115·9	46·5	—	9	4	6	11	—	6·3	10	1·72
BARNET (Gas Works), T. H. Martin, Esq., C.E.	212	April	—	—	64·9	27·0	37·9	55·0	37·4	17·6	44·9	37·2	·221	2·6	0·8	74	547	—	—	—	—	—	—	—	—	—	8	0·44
		May	—	—	76·2	27·0	52·2	64·3	40·2	24·3	51··	44·2	·290	3·3	1·0	75	540	—	—	—	—	—	—	—	—	—	14	1·13
		June	—	—	79·7	35·9	45·8	68·7	46·8	21·9	56·5	49·7	·358	4·0	1·1	78	533	—	—	—	—	—	—	—	—	—	13	1·83
OXFORD (The Observatory), E. J. Stone, Esq., M.A., F.R.S.	210	April	29·727	0·608	63·0	27·9	35·1	55·3	37·6	17·9	45·8	·8·5	·235	2·7	0·8	76	545	110·5	24·7	3·5	9	9	5	7	3·2	6·9	9	0·68
		May	29·869	1·196	74·6	29·6	44·0	63·8	44·3	19·5	53·6	44·9	·296	3·4	1·3	72	539	114·4	30·5	2·7	9	6	8	8	2·3	5·5	12	1·34
		June	29·746	0·945	78·5	38·5	40·0	66·6	50·5	16·1	58·2	48·9	·345	3·9	1·6	72	531	119·5	46·6	2·3	5	4	11	10	2·2	6·9	15	1·70
GLOUCESTER COUNTY ASYLUM, E. Toller, Esq., M.R.C.S., F.M.S.	160	April	29·846	0·650	67·5	33·5	34·0	57·3	36·8	20·5	46·0	42·4	·272	3·2	0·4	88	547	110·3	34·0	0·4	6	13	3	8	—	5·0	3	0·62
		May	29·808	1·180	84·0	38·0	36·0	68·0	42·7	25·3	54·4	49·6	·335	4·0	0·8	88	540	122·3	39·4	0·3	7	9	2	12	2·1	5·7	7	1·11
		June	29·861	0·814	84·0	35·0	51·0	69·2	48·0	21·2	56·4	50·9	·365	4·2	0·9	83	535	124·0	44·1	1·5	7	4	5	16	5·1	5·4	16	2·75
ROYSTON (Hertfordshire), Hale Wortham, Esq., F.R.A.S., F.M.S.	269	April	29·689	0·624	67·0	33·0	33·1	55·8	35·6	20·2	44·5	38·0	·259	2·7	0·7	77	545	—	—	—	—	10	9	6	5	—	6·5	10	1·02
		May	29·838	1·180	76·8	28·7	48·1	65·6	42·6	23·0	53·0	44·2	·290	3·3	1·2	72	539	—	—	—	—	9	7	5	10	—	5·5	11	0·66
		June	29·714	0·858	81·3	35·3	46·0	69·8	48·3	21·5	56·7	50·3	·365	4·1	1·1	80	532	—	—	—	—	5	5	8	8	—	6·9	10	1·69
BEDFORD, Cardington, Mr. J. McLaren, Assistant; to S. Whitbread, Esq., M.P.	105	April	29·818	0·596	69·6	30·2	40·4	55·9	36·2	19·7	45·3	38·2	·251	2·7	0·8	76	547	99·0	27·8	2·5	6	15	4	5	—	5·4	9	1·10
		May	29·950	1·230	79·4	27·0	52·4	66·5	42·4	23·5	53·7	44·0	·287	3·2	1·4	70	540	105·7	28·5	1·9	10	6	3	10	—	5·5	10	0·65
		June	29·820	—	84·0	42·0	41·0	72·9	50·5	22·4	57·7	50·4	·366	4·1	1·2	78	534	115·9	47·3	1·6	4	1	12	10	—	6·4	11	2·03
CAMBRIDGE (Trinity College), J. W. L. Glaisher, Esq., M.A., F.R.S.	40	April	29·859	0·588	70·0	29·0	41·0	57·5	35·8	21·7	45·0	38·5	·233	2·7	0·7	78	549	110·7	29·0	1·1	9	11	6	4	—	6·1	14	1·04
		May	29·927	1·265	83·0	27·6	55·4	68·1	42·8	25·3	54·0	44·9	·297	3·4	1·3	71	541	114·1	30·3	0·8	9	8	5	9	—	5·2	13	2·07
		June	29·907	0·828	85·8	36·5	47·3	72·0	47·6	24·4	57·8	50·2	·361	4·0	1·3	76	535	127·0	42·7	0·7	8	3	10	9	—	6·4	11	2·68
RUGBY (Warwickshire), Stockton, The Rectory, Rev. W. Tuckwell.	289	April	29·629	0·590	64·5	25·0	39·5	54·6	35·0	19·6	44·0	37·7	·226	2·6	0·7	77	545	—	—	0·7	10	10	5	5	—	5·9	7	0·58
		May	29·749	1·174	76·5	23·0	53·5	65·5	40·1	25·4	51·9	44·1	·290	3·3	1·1	74	539	—	—	0·4	9	8	8	6	—	5·0	8	0·97
		June	29·677	0·895	82·0	33·0	49·0	68·3	46·1	22·2	56·1	49·5	·358	4·0	1·0	78	532	—	—	0·5	6	8	11	5	—	6·5	14	2·06

MONTHLY METEOROLOGICAL TABLE FOR THE QUARTER ENDING MARCH 31st, 1881.

The Observations have been reduced to Mean values by Glaisher's Barometrical and Diurnal Range Tables, and the Hygrometrical results have been deduced from the sixth edition of his Hygrometrical Tables.

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1881. Months.	Pressure of Atmosphere in Month. Mean.	Pressure of Atmosphere in Month. Range.	Temperature of Air in Month. Highest.	Lowest.	Range.	Mean of all Highest.	Mean of all Lowest.	Mean Daily Range.	Mean Temperature. Air.	Dew Point.	Vapour. Elastic Force.	In a cubic foot of Air. Mean.	Short of Saturation.	Mean Degree of Humidity. Sat°. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer. Maximum in Rays of Sun.	Minimum on Grass.	Wind. Estimated Strength.	Relative Proportion of N.	E.	S.	W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									
GUERNSEY, Adolphus Collenette, Esq., F.M.S.	204	Jan.	29·678	1·673	52·0	24·5	27·5	42·1	34·5	7·6	38·4	34·0	·193	2·3	0·5	83	552	63·4	31·5	1·7	11	11	4	5	2·6	5·9	19	4·49
		Feb.	29·679	1·222	53·5	35·0	20·5	47·6	39·7	7·9	43·0	41·5	·262	2·9	0·3	94	547	70·0	37·3	1·7	7	10	6	5	3·3	6·8	17	4·29
		Mar.	29·756	1·159	64·0	30·5	33·5	52·2	42·2	10·0	46·2	43·2	·280	3·3	0·4	90	545	82·8	39·2	1·7	7	9	6	9	1·9	4·9	13	2·22
TRURO (Cornwall), C. Barham, Esq., M.D., F.M.S.	43	Jan.	29·845	1·742	53·0	12·0	41·0	42·6	28·0	14·6	34·5	32·2	·190	2·1	0·3	91	560	—	—	1·7	13	12	5	4	—	7·1	10	2·50
		Feb.	29·789	1·121	54·0	25·0	29·0	48·3	37·1	11·2	42·4	40·6	·254	3·0	0·3	94	551	—	—	2·5	6	9	5	8	—	7·9	16	4·36
		Mar.	29·856	1·396	58·0	19·0	39·0	52·0	19·0	13·0	44·2	39·4	·242	2·8	0·4	83	549	—	—	2·7	10	6	5	10	—	6·9	14	3·86
PLYMOUTH (Devon), J. Merrifield, Esq., LL.D., F.R.A.S., F.M.S.	69	Jan.	29·850	1·697	51·0	17·0	34·0	39·6	28·8	10·8	34·1	30·6	·171	2·0	0·3	87	560	—	—	1·3	11	14	3	3	—	7·2	12	1·54
		Feb.	29·826	1·158	52·6	26·5	26·1	47·3	36·6	10·7	41·2	38·3	·231	2·7	0·3	91	552	—	—	2·0	8	9	5	6	—	7·1	15	3·71
		Mar.	29·900	1·335	57·9	30·3	27·6	50·8	38·7	12·1	44·2	41·1	·248	2·9	0·4	85	5·0	—	—	1·8	8	8	6	9	—	6·3	12	4·15
TOTNES (Devon), T. H. Edmonds, Esq.	107	Jan.	29·872	1·740	54·2	8·8	45·4	41·1	23·7	15·4	32·5	29·4	·164	1·9	0·2	88	563	69·2	22·2	—	10	11	5	5	—	7·0	14	3·07
		Feb.	29·800	1·253	55·1	18·3	36·8	47·0	34·7	12·3	40·7	37·5	·224	2·6	0·3	89	552	76·4	32·2	—	9	9	3	7	—	8·2	19	5·94
		Mar.	29·924	1·429	64·2	9·1	55·1	52·2	36·7	15·5	43·7	38·5	·234	2·7	0·5	81	551	95·0	32·9	—	8	8	5	10	—	6·5	14	4·86
TORQUAY, Babbacombe (Devon), Edwin E. Glyde, Esq., F.M.S.	305	Jan.	29·519	1·746	54·9	15·3	39·6	40·6	29·3	11·1	35·2	31·1	·174	2·1	0·3	84	558	75·8	22·5	1·6	10	12	4	5	—	7·1	14	2·44
		Feb.	29·496	1·335	51·2	26·1	25·1	44·6	36·2	8·2	40·4	36·4	·215	2·4	0·3	85	547	77·8	29·9	1·7	7	8	6	7	5·7	8·2	19	4·66
		Mar.	29·566	1·476	59·0	21·3	37·7	49·8	38·3	11·5	43·8	38·3	·231	2·7	0·6	81	544	104·0	30·8	1·8	5	8	5	13	5·2	6·9	10	4·56
VENTNOR, (Isle of Wight) (Royal National Hospital for Consumption), J. Codling, Esq.	150	Jan.	29·782	1·602	50·9	14·6	36·3	40·6	29·2	11·4	34·4	32·3	·183	2·1	0·2	92	559	—	—	—	15	9	2	5	—	6·8	13	3·25
		Feb.	29·741	1·210	53·4	27·0	26·4	45·6	35·7	9·9	39·7	36·0	·212	2·4	0·2	87	552	—	—	—	9	7	4	8	4·0	6·0	15	4·14
		Mar.	29·822	1·204	60·2	31·0	29·2	51·1	39·0	12·1	43·7	39·1	·239	2·7	0·4	84	549	—	—	—	8	9	4	10	5·0	6·0	12	2·60
EASTBOURNE (Sussex), Miss W. L. Hall.	12	Jan.	29·806	1·500	49·1	12·8	36·3	39·0	27·8	11·2	33·8	29·9	·166	1·9	0·3	85	560	60·7	17·5	0·2	14	10	3	4	0·8	—	11	1·18
		Feb.	29·728	1·270	51·0	24·0	27·0	44·4	34·0	10·4	39·3	36·3	·215	2·5	0·2	90	552	70·8	24·8	0·2	12	7	5	4	1·0	—	17	3·28
		Mar.	29·846	1·176	62·2	25·5	36·7	50·8	36·4	14·4	43·1	38·3	·232	2·7	0·5	83	550	97·6	25·4	0·3	7	8	6	10	1·7	—	12	3·23
OSBORNE (Isle of Wight), J. R. Mann, Esq.	172	Jan.	29·683	1·680	50·3	12·0	38·3	37·8	26·7	11·1	32·4	30·5	·171	2·0	0·1	93	559	48·2	13·3	0·5	12	9	5	5	—	6·4	6	2·08
		Feb.	29·651	1·214	53·0	25·0	28·0	44·3	33·9	10·4	38·8	36·8	·219	2·6	0·2	91	551	70·2	31·3	0·5	8	8	7	5	—	7·3	13	2·78
		Mar.	29·721	1·354	62·8	24·1	38·7	51·9	37·5	14·4	43·5	39·2	·239	2·8	0·4	84	547	96·3	34·3	0·4	6	8	8	9	—	5·9	9	2·09
BRIGHTON (Sussex), F. E. Sawyer, Esq., F.M.S.	200	Jan.	29·664	1·624	49·0	11·4	37·6	36·7	27·6	9·1	32·5	28·5	·156	1·8	0·3	85	559	—	24·5	0·9	16	8	3	4	—	6·7	11	2·50
		Feb.	29·614	1·245	50·6	27·0	23·6	42·8	34·8	8·0	38·8	35·0	·205	2·4	0·4	87	551	—	31·8	1·0	10	7	5	6	—	8·3	14	3·04
		Mar.	29·705	1·181	57·0	24·6	32·4	48·0	36·5	11·5	42·1	34·5	·201	2·4	0·7	79	549	—	33·1	0·9	5	8	5	13	—	6·5	11	2·50
BOURNEMOUTH, South Bourne (Hants), T. A. Compton, Esq., B.A., M.D., F.M.S.	95	Jan.		1·622	47·8	19·2	35·6	37·5	27·1	10·4	32·2	28·4	·155	1·9	0·2	85	562	—	—	1·0	17	8	2	4	—	5·7	11	2·22
		Feb.		1·223	51·3	24·1	27·2	43·6	34·3	9·3	38·7	33·8	·195	2·2	0·5	83	554	—	—	1·2	10	8	5	5	—	7·0	14	3·70
		Mar.		1·327	59·9	24·2	35·7	49·7	37·3	12·4	42·6	37·5	·223	2·7	0·4	82	551	—	—	1·2	9	9	2	11	—	5·4	13	2·46
SALISBURY (Wilton House), Wilts, Thomas Challis, Esq.	186	Jan.	29·687	1·736	52·0	2·5	49·5	37·1	21·6	15·5	29·7	27·2	·148	1·8	0·2	89	563	52·0	20·6	1·2	13	13	2	3	—	6·9	11	2·80
		Feb.	29·629	1·300	52·0	19·5	32·5	45·0	31·3	13·7	38·6	35·3	·207	2·4	0·3	88	551	64·4	27·0	1·5	9	8	6	5	—	7·5	16	3·90
		Mar.	29·690	1·346	63·0	18·0	45·0	52·3	35·1	17·2	42·5	38·7	·236	2·7	0·4	87	548	89·8	29·7	1·3	9	8	5	9	—	5·8	12	2·67
BARNSTAPLE (Devon), William Knill, Esq.	43	Jan.	29·818	1·770	52·0	8·0	44·0	39·2	26·7	12·5	32·9	30·8	·172	2·0	0·2	90	561	—	—	1·0	10	15	4	2	—	4·5	11	1·74
		Feb.	29·772	1·240	54·0	28·0	26·0	47·3	37·6	9·7	42·2	38·7	·235	2·7	0·4	82	550	—	—	1·2	6	10	6	6	—	4·8	15	3·83
		Mar.	29·851	1·480	58·0	29·0	[illegible]	55·1	39·2	15·9	45·4	39·4	·242	2·8	0·6	79	547	—	—	1·4	4	10	7	10	—	4·3	16	2·93

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1881.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat^{n}. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a Cubic foot of Air.						Relative Proportion of							
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short Saturation.			Maximum in Rays of Sun.	Minimum on Grass.	Estimated Strength.	N.	E.	S.	W.			Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in.
RAMSGATE (Kent), Rev. T. E. Egan, O.S.B.	108	Jan.	29·770	1·561	49·6	15·0	34·6	38·0	29·1	8·9	39·4	30·0	·167	1·9	0·3	87	560	—	—	1·3	2	16	6	7	—	7·0	15	1·15
		Feb.	29·722	1·253	50·4	27·2	23·2	42·7	34·0	8·7	37·7	34·7	·201	2·3	0·3	88	554	—	—	1·6	7	8	7	6	—	7·4	25	1·79
		Mar.	29·778	1·210	57·5	27·2	30·3	48·3	38·1	10·2	42·7	39·0	·237	2·7	0·4	86	549	—	—	1·4	4	7	8	12	—	7·0	16	1·70
STRATHFIELD TURGISS (Hants), Rev. C. H. Griffith, M.A., F.M.S.	197	Jan.	29·671	1·719	49·1	3·9	45·2	36·3	23·3	13·0	39·1	26·5	·142	1·6	0·4	85	562	50·0	18·1	0·9	10	10	4	7	1·0	6·6	10	1·24
		Feb.	29·632	1·363	53·5	23·2	30·3	43·5	32·8	10·7	37·8	34·8	·203	2·3	0·3	89	552	63·8	28·1	1·1	7	8	8	5	1·1	8·1	12	2·23
		Mar.	29·681	1·381	62·1	22·3	39·8	52·3	34·4	17·9	42·4	37·6	·225	2·6	0·5	84	548	91·0	28·2	1·3	6	8	4	13	1·8	5·4	12	1·56
BATH (Somerset), St. Gregory's College, Downside, Rev. T. J. Almond, O.S.B., F.M.S.	506	Jan.	29·204	1·672	47·2	8·8	38·4	35·4	25·3	10·1	30·3	28·4	·156	1·8	0·2	92	553	61·5	23·6	1·2	9	10	5	7	—	7·1	9	1·15
		Feb.	29·168	1·315	51·6	23·9	25·7	42·6	31·4	9·2	37·7	35·8	·210	2·5	0·2	92	544	70·9	31·2	1·8	6	9	6	7	—	7·8	17	5·78
		Mar.	29·212	1·367	60·0	22·9	37·1	48·4	35·1	13·3	41·3	39·0	·239	2·7	0·3	92	540	87·9	32·7	1·5	6	8	6	11	—	6·7	14	3·41
MARLBOROUGH (Wilts), Rev. Thomas A. Preston, M.A., F.M.S.	474	Jan.	29·365	1·684	48·8	6·9	41·9	35·2	24·5	10·7	29·4	26·4	·144	1·7	0·2	89	557	56·7	20·7	0·5	7	18	1	5	—	7·5	10	2·68
		Feb.	29·316	1·322	49·8	24·4	25·4	42·3	32·9	9·4	37·4	34·8	·202	2·3	0·3	91	546	67·8	29·0	0·7	4	13	6	5	—	7·1	15	3·67
		Mar.	29·371	1·284	61·0	22·3	38·7	50·2	34·2	16·0	41·4	36·7	·218	2·5	0·5	84	543	92·8	29·1	0·8	3	10	3	15	—	5·5	14	2·77
BLACKHEATH (Kent), James Glaisher, Esq., F.R.S.	100	Jan.	29·708	1·699	48·0	9·2	38·8	36·0	27·3	8·7	31·7	28·3	·155	1·8	0·2	92	560	52·8	24·5	0·8	6	9	7	9	—	8·0	7	2·16
		Feb.	29·647	1·394	52·1	28·2	23·9	41·9	34·3	7·6	37·9	34·6	·200	2·3	0·3	88	552	71·5	31·9	1·4	7	8	4	9	—	8·3	15	2·51
		Mar.	29·715	1·302	59·8	24·2	35·6	50·9	36·3	14·6	42·9	36·3	·213	2·5	0·7	78	548	100·9	32·7	1·4	4	9	5	13	—	6·3	12	1·59
WHITCHURCH RECTORY (Oxon), (near Reading). Rev. J. Slatter, M.A., F.R.S., F.M.S	150	Jan.	29·707	1·737	44·3	5·3	39·0	35·1	23·9	11·2	29·8	28·1	·154	1·9	0·1	93	563	—	—	0·6	12	8	4	7	—	7·2	10	1·65
		Feb.	29·647	1·357	50·8	24·8	25·0	42·9	34·2	8·7	38·6	37·2	·222	2·6	0·1	95	551	—	—	1·0	7	9	4	8	—	8·5	9	2·73
		Mar.	29·735	1·263	58·0	23·6	34·4	50·3	34·8	15·5	42·0	37·0	·220	2·7	0·4	88	549	—	—	1·1	3	12	7	9	—	5·7	11	2·00
CAMDEN SQUARE (London), G. J. Symons, Esq., F.R.S., F.M.S.	123	Jan.	29·751	1·657	48·4	11·8	36·6	36·7	26·1	10·6	31·6	29·0	·159	1·9	0·2	89	562	50·0	21·9	—	11	9	4	7	—	7·3	8	1·85
		Feb.	29·696	1·263	52·7	26·7	26·0	42·8	33·9	8·9	38·2	35·1	·206	2·4	0·3	87	553	53·9	31·8	—	10	8	6	6	—	8·0	16	3·69
		Mar.	29·760	1·228	60·3	23·7	36·6	51·1	36·1	15·0	42·9	37·4	·224	2·6	0·4	81	549	87·8	32·4	—	8	7	5	11	—	6·3	11	2·30
OXFORD (The Observatory), E. J. Stone, Esq., M.A., F.R.S.	210	Jan.	29·673	1·759	48·7	6·8	41·9	35·2	24·7	10·5	29·7	—	—	—	—	—	—	61·6	22·8	1·8	11	9	3	8	0·2	7·0	13	1·00
		Feb.	29·606	1·380	52·0	21·5	26·5	43·4	34·7	8·7	38·0	36·1	·212	2·5	0·2	93	541	68·2	32·9	2·4	10	6	7	5	1·1	8·5	29	1·52
		Mar.	29·668	1·365	59·2	23·4	35·8	50·3	35·5	14·8	41·4	37·0	·220	2·6	0·5	84	548	100·5	32·8	1·4	5	7	5	13	2·3	6·1	13	1·40
GLOUCESTER COUNTY ASYLUM, E. Toller, Esq., M.R.C.S., F.M.S.	100	Jan.	29·823	1·802	50·0	6·0	44·0	35·3	22·5	12·8	28·6	25·5	·137	1·6	0·2	87	566	47·0	20·5	0·6	15	9	4	3	—	—	4	0·88
		Feb.	29·719	1·394	52·0	16·5	35·5	44·6	32·1	12·5	38·6	37·1	·222	2·6	0·1	93	553	62·5	31·8	1·0	10	6	8	4	—	8·4	17	2·74
		Mar.	29·809	1·436	61·0	20·0	41·0	52·5	33·8	18·7	42·5	39·2	·240	2·8	0·2	88	550	94·3	32·1	0·3	6	6	6	13	1·6	5·8	6	1·32
ROYSTON (Hertfordshire), Hale Wortham, Esq., F.R.A.S., F.M.S.	269	Jan.	29·629	—	45·6	7·7	37·9	34·4	23·0	11·4	29·5	28·9	·147	1·7	0·2	90	562	—	—	—	8	5	8	10	—	6·8	12	1·35
		Feb.	29·549	1·345	51·7	23·4	28·3	41·7	31·2	10·5	36·7	34·0	·196	2·3	0·3	91	552	—	—	—	10	6	8	4	—	8·4	17	2·74
		Mar.	29·619	1·367	60·3	19·0	41·3	50·3	34·4	15·9	41·5	36·0	·212	2·5	0·6	82	548	—	—	—	5	6	8	12	—	6·1	9	1·18
BEDFORD, Cardington, Mr. J. McLaren, Assistant to S. Whitbread, Esq., M.P.	105	Jan.	29·780	1·804	47·4	0·0	47·4	35·1	22·6	12·5	28·5	25·7	·130	1·6	0·2	89	565	40·0	22·4	0·9	9	7	5	10	—	6·7	8	0·72
		Feb.	29·693	1·520	53·0	24·6	28·4	42·1	32·8	9·3	37·6	35·5	·209	2·3	0·3	91	553	51·7	31·3	1·7	7	10	5	6	—	8·4	20	2·50
		Mar.	29·746	1·400	59·0	21·4	37·6	50·4	33·6	16·8	41·6	36·7	·218	2·5	0·5	83	550	75·7	29·9	2·1	8	7	5	11	—	6·1	12	1·30
CAMBRIDGE (Trinity College), J. W. L. Glaisher, Esq., M.A., F.R.S.	40	Jan.	29·835	1·798	49·3	2·0	51·3	35·7	24·6	11·1	29·8	27·3	·149	1·7	0·2	91	565	56·1	21·4	1·0	12	5	7	7	—	6·2	17	1·39
		Feb.	29·770	1·444	54·0	26·0	28·0	42·1	33·6	8·5	37·8	35·0	·204	2·4	0·3	90	555	66·0	30·2	1·3	9	7	8	4	—	9·0	20	2·46
		Mar.	29·848	1·408	61·3	21·0	40·3	51·9	34·4	17·5	42·3	37·4	·224	2·6	0·4	84	551	100·1	28·1	1·2	6	7	5	13	—	6·1	12	1·11
RUGBY (Warwickshire), Stockton, "The Rectory," Rev. W. Tuckwell.	289	Jan.	29·553	1·678	45·6	5·0	42·0	35·4	21·1	14·3	28·4	26·6	·144	1·7	0·1	94	562	—	21·2	0·2	10	7	7	7	—	6·6	8	0·65
		Feb.	29·499	1·459	50·0	20·0	30·0	43·9	32·1	11·8	37·5	34·3	·214	2·4	0·2	93	550	—	—	0·4	8	8	8	4	5·6	8·0	19	2·04
		Mar.	29·572	1·206	60·0	16·5	43·5	50·6	31·9	18·7	41·0	37·4	·223	2·6	0·4	86	545	—	—	0·5	5	6	5	15	0·0	5·5	13	1·22
LOWESTOFT (Suffolk), H. Miller, Esq., F.R.A.S., F.M.S.	85	Jan.	29·787	1·711	48·0	9·2	38·8	36·7	27·4	9·3	32·3	29·1	·161	1·9	0·2	87	561	54·6	25·5	0·6	6	8	6	11	—	6·3	16	1·67
		Feb.	29·730	1·394	49·0	27·4	21·6	41·2	33·0	8·2	37·3	34·4	·199	2·3	0·3	89	554	62·4	31·0	0·6	7	8	6	7	—	8·1	19	2·25
		Mar.	29·770	1·332	60·1	23·0	37·1	48·0	35·3	12·7	41·2	37·2	·221	2·6	0·5	85	551	88·2	31·6	0·9	6	7	4	14	—	5·4	14	1·79

Meteorological Tables, Quarter ending June 30th, 1881.

Year 1881.	Mean Pressure of dry Air reduced to the level of the Sea.	Mean of all Highest.	Mean of all Lowest.	Mean Monthly Range of Temperature.	Mean Daily Range of Temperature.	Mean Temperature of the Air.	Mean Temperature of the Dew Point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Mean additional Weight required for saturation.	Mean degree of Humidity.	Mean Weight of a cubic foot of Air.	Mean Reading of Maximum in Rays of Sun.	Mean Reading of Minimum on Grass.	Wind. Mean Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Mean Amount of Cloud.
	in.	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°							
1881	29·705	75·0	36·0	39·0	57·7	46·6	29·5	11·1	51·1	46·6	·319	3·6	0·7	83	539	103·9	42·4	1·3	8	7	6	9	4·8	4·5
1880	29·715	78·4	29·5	49·0	61·0	45·7	38·7	15·9	51·9	44·9	·307	3·4	1·0	78	545	114·9	47·6	1·4	7	8	7	9	4·9	4·0
1879	29·704	81·1	26·7	54·4	63·4	48·1	46·1	20·2	52·2	45·1	·303	3·5	1·0	77	538	113·5	48·7	1·5	7	8	6	10	2·7	5·3
1878	29·710	80·4	25·9	54·5	62·1	42·4	45·2	19·6	50·9	43·7	·289	3·3	1·0	76	540	112·0	34·3	0·9	8	9	7	7	4·1	5·4
1877	29·712	78·3	26·6	50·7	53·2	43·1	38·9	16·1	50·1	42·6	·283	3·2	1·0	76	540	91·4	38·4	1·1	5	8	6	11	4·5	6·0
1876	29·684	75·0	24·0	50·9	59·4	41·9	41·2	17·6	49·5	43·0	·287	3·2	0·9	78	543	104·2	35·7	1·1	4	10	5	11	4·7	6·3
8	29·510	80·6	28·0	58·8	62·6	46·1	39·2	16·5	52·9	46·9	·325	3·7	0·9	81	536	104·8	41·6	1·1	5	9	9	8	4·3	5·9
9	29·542	70·7	27·1	43·6	57·0	42·1	32·9	14·9	48·2	42·9	·282	3·2	0·7	82	540	96·2	37·7	1·1	7	7	8	9	5·0	6·8
0	29·661	76·6	31·5	44·5	59·9	43·8	35·7	16·1	50·6	44·4	·297	3·5	0·8	80	539	104·0	38·5	1·2	7	8	6	9	4·6	6·4
1	29·705	78·8	26·5	51·0	61·0	43·1	41·8	17·9	51·0	43·9	·294	3·3	1·0	77	541	107·2	38·9	1·2	6	9	6	10	4·2	5·9

NAMES of STATIONS and OBSERVERS.

...ures of the air were at Salisbury 86°·5 Gloucester, 84° Cambridge, 83°·8 and Cardington, 83°.

...res of the air were at Bywell, 18° Salisbury 22°·5 Cockermouth 22°·8 Cambridge, 23° ; and Lancaste

...nges of temperatures were at Salisbury, 26° Cambridge, 23°·8 Stockton, 22°·4 ; and Gloucester, 22°·3.

...of temperatures were at Guernsey 19°·1 Llandudno, 12° Lowestoft, 12°·3 ; and Liverpool, 12°·6.

...of days of rain were at Bolton, 49 ; Bradford, 47 and Liverpool 45.

...days of rain were at Caterham, 23 ; Osborne 25 and Gloucester, 26.

...rain in the quarter were at Stonyhurst, 10·34 inches and Bolton, 10·30 inches.

...n in the quarter were at Strathfield Turgiss, 3·25 inches ; and Royston, 3·07 inches.

QUARTERLY METEOROLOGICAL TABLE for different PARALLELS of LATITUDE.

METEOROLOGY OF ENGLAND,

DURING THE QUARTER ENDING SEPTEMBER 30, 1881.

REMARKS ON THE WEATHER DURING THE QUARTER ENDING SEPTEMBER 30TH, 1881.

By JAMES GLAISHER, Esq., F.R.S., *&c.*

The weather in July was very different in different places, at many in England between the latitudes of 51° and 53° it was very fine, the temperature exceeding 90° on one or two days, and exceeding 80° on several days. The excessive heat caused a rapid ripening of crops, and the weather was all that could be desired for agricultural work in this part of the country; but in Wales between the same parallels of latitude the temperature reached 80° at only a few places and with the exceptions of the 8th to the 16th, when the weather was fine, it was variable and showery. In Cumberland and Westmorland the weather was cold and moist, the Observer at Cockermouth says "the month was cold, cloudy, and wet and was 1°·8 below the average of 19 years." In Cornwall and Devonshire the temperature was not remarkably high and North of 53°, the weather was cold. Tuesday the 5th July was generally a hot day, a thunder storm occurred, and on July 6th, at many stations the maxima shade temperatures were 20°, 30°, and 35° lower than the maxima temperatures of the preceding day. On the night of the 27th and 28th of July a remarkably low temperature occurred in Cornwall and Devonshire, extending into Wiltshire, seriously injuring young potatoes and French beans; the temperature of this night was the lowest in the quarter in those counties.

The weather in August during the first week was generally fine and dry, then cold, cloudy, and unseasonable during the remainder of the month, with almost constant rain interfering most seriously with the ingathering of the harvest; wheat was generally injured and in many places was mildewed. Falls of rain exceeding one inch in 24 hours took place at Bath on the 8th; at Strathfield Turgiss on the 11th; at Ramsgate on the 12th; at Hull twice, on the 16th and 23rd; at Wilton House twice, on 19th and 20th; at Totnes and Torquay on the 22nd; at Osborne on the 23rd; at Leicester and Nottingham on the 24th; at Bolton twice on the 25th and 29th; at Halifax on the 26th; at Somerleyton on the 29th; and at Barnet on the 30th. From the end of the first week to the end of the month, both the pressure of the atmosphere and temperature of the air were below their averages.

The weather in September during the first half of the month was cold, and the readings of the barometer below their averages, the remainder of the month was moderately fine; there were frequent showers of rain; the temperature of the dewpoint was above its average, whilst the temperature of the air was below its average, so that the air was more humid than usual and nothing would dry, greatly impeding harvest operations.

About London the mean daily temperature of the air was above its average till the 5th of July, which was a hot day being 14°·8 above its average, and the mean daily excess of temperature of these 5 days was 8°·8; from the 6th to the 9th was cold, the average daily deficiency of temperature being 4°; then for 11 days the temperature was high; on the 15th the excess of mean temperature was 12°·7 and on this day temperatures exceeding 90° were recorded at many stations; the average daily excess of mean temperature for these 11 days was 6°·6; a fortnight of cold weather followed extending to August 3rd, the average daily deficiency being 2°·3; then for 5 days, till August 8th, the temperature was moderately warm, resulting in a mean of 2°·5 daily of excess of temperature; from August 9th till the middle of September it was constantly cold, every day being below its average temperature and for these 39 consecutive days, the deficiency of mean temperature was on the average 4°·2 daily; from the 17th September to the 26th there was a period of a little better weather, the average daily excess of these 10 days was 2°, and there was a daily deficiency of temperature for the next 4 days of 2°·2.

On looking over the Table on the next page, it will be seen how very great the difference of maximum daily temperatures has been at the different places; on the 1st the temperature exceeded 80° at several stations between Blackheath and Norwich, the highest being 87°·6 at Bedford; whilst at Liverpool the temperature only reached 62°·7, and at Llandudno 63°·7; on the 2nd the extremes were at Eastbourne and Salisbury 80° and 80°·5; at Bradford and Llandudno 60° and 60°·7 respectively; on the 3rd there were many places between Salisbury and Leeds, with readings of 80° or more, the highest was 84°·7 at Greenwich; whilst at Lancaster the highest reading was 63°, and at Bristol 66°·3; on the 4th there were several stations between Truro and Leeds with readings exceeding 80°; the highest was 90°·3 at Nottingham, whilst at Lancaster the highest reading was 62°, and at Carlisle 66°·3. On the 5th, temperatures exceeding 90° took place at many stations between Salisbury and Nottingham, the highest being 93°·5 at Salisbury; on this day the maximum temperature at Bermerside was 61°, at Truro was 64°, and at Torquay was 68°·6. On the 11th the extremes were 86° at Sunderland, and 56° at Liverpool; on the 12th, temperatures exceeding 80° were recorded at several stations between Osborne and Nottingham, the highest was 86°·2 at Greenwich; whilst at Liverpool the highest was 59°, and at Lancaster 66°. On the 13th the extremes were 83°·9 at Whitchurch, and 60° at Bermerside; on the 14th the temperature exceeded 80° at many places, and was 91°·3 at Whitchurch, and 91° at Sunderland, whilst at Lancaster it was 63°, and at Torquay 67°·7. The most remarkable day is the 15th, the highest temperature was 97°·1 at Greenwich; the next in order 95°·6 at Osborne; 94°·6 at Camden Square, and 94° at Blackheath; several other stations above 90°, and many between 80° and 90. On this day at Bermerside the highest temperature was 64°, and at Liverpool and Lancaster 66°.

The following Table shows the maximum temperature at the several stations, during the periods of high temperatures.

TABLE showing the MAXIMUM TEMPERATURES at the several Stations on July 1st to 5th, and from July 11th to 19th.

Names of Stations.	JULY, 1881.												
	1st.	2nd.	3rd.	4th.	5th.	11th.	12th.	13th.	14th.	15th.	16th.	17th.	18th.	19th.
	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Guernsey	67·5	68·0	71·0	77·0	82·0	75·0	69·0	70·0	75·0	83·0	78·0	74·0	78·0	74·5
Truro	68·0	72·0	74·0	80·0	82·0	74·0	70·0	74·0	80·0	79·0	71·0	83·0	80·0	70·0
Plymouth	68·2	69·0	70·8	79·8	79·0	70·8	73·5	73·2	69·2	82·0	78·5	72·0	69·4	75·8
Totnes	70·0	73·3	74·0	83·6	75·8	75·6	75·7	76·4	75·2	87·5	83·7	80·4	82·3	82·3
Torquay	69·1	72·5	76·9	73·1	68·6	70·9	75·5	77·2	67·7	82·8	77·5	77·3	76·0	76·4
Eastbourne	78·7	80·0	73·1	81·0	82·5	77·9	79·0	77·0	84·7	87·7	82·2	81·9	82·8	85·3
Ventnor	70·5	74·2	69·1	74·4	77·5	71·4	72·8	76·7	76·9	81·9	80·6	75·9	78·0	81·8
Osborne	74·9	79·0	76·0	85·4	83·2	82·0	82·6	77·9	84·3	95·6	92·1	85·8	86·2	90·4
Brighton	68·2	76·8	75·0	75·0	82·0	70·0	76·1	71·0	76·7	81·0	79·0	72·8	74·4	80·2
Bournemouth	69·9	72·2	70·4	71·9	78·8	66·0	77·4	71·8	69·7	74·8	80·2	75·8	73·1	79·1
Salisbury	78·0	80·5	82·5	85·5	93·5	79·0	80·5	80·5	88·0	93·5	87·5	85·5	85·0	92·0
Barnstaple	69·0	69·0	74·0	71·0	82·0	74·0	79·0	72·0	71·0	80·0	77·5	76·0	77·0	73·0
Bath	65·4	69·8	71·3	75·1	83·8	70·0	69·5	66·5	77·9	80·0	77·7	77·8	77·7	76·3
Ramsgate	73·2	74·2	80·5	83·0	79·7	75·5	80·7	80·4	80·2	85·3	74·2	82·3	85·3	84·7
Strathfield Turgiss	79·8	76·4	80·8	85·2	90·0	78·4	81·1	78·8	87·5	99·8	84·8	86·0	85·4	88·0
Marlborough	74·0	70·5	75·1	78·4	86·9	75·4	74·4	71·2	82·9	87·1	80·4	80·2	81·1	84·0
Bristol	67·5	70·0	66·3	72·2	86·0	73·1	69·6	65·3	78·0	79·0	75·9	74·8	74·0	75·4
Blackheath	81·7	75·0	82·8	88·0	92·5	79·0	83·0	81·0	86·2	94·0	85·3	83·0	88·4	86·1
Greenwich	82·6	77·1	84·7	90·0	92·8	79·6	86·2	81·4	89·1	97·1	84·3	85·2	90·2	88·9
Whitehurch	80·9	76·3	80·7	85·3	91·0	79·6	79·8	83·9	91·3	83·7	84·0	85·0	87·2	73·4
Camden Square	82·6	79·7	82·3	89·2	92·7	79·1	82·4	83·7	87·4	94·6	84·5	84·4	88·7	89·2
Barnet	80·8	78·2	80·2	86·0	92·5	78·5	80·0	78·2	86·2	92·2	82·0	83·0	87·0	88·9
Oxford	75·3	72·4	76·0	83·9	87·3	75·9	74·8	76·0	84·5	86·9	77·3	78·4	81·5	82·6
Gloucester	74·5	—	75·0	81·0	85·0	80·0	78·0	75·0	83·0	89·0	80·0	81·0	82·0	82·0
Royston	82·3	77·6	79·5	86·7	90·6	80·4	82·0	78·0	86·6	93·0	80·1	82·9	85·2	86·7
Cardington	87·6	75·0	81·4	87·4	91·4	81·0	79·6	79·6	84·6	91·6	79·6	82·0	87·4	86·6
Somerleyton	77·1	71·2	80·2	87·3	79·3	81·0	82·0	76·5	82·7	88·5	72·5	76·6	90·3	84·1
Lowestoft	69·0	66·9	79·8	87·0	74·0	74·1	73·7	76·7	74·0	78·4	69·9	67·2	85·2	80·6
Cambridge	81·0	78·8	83·0	88·0	93·0	81·0	84·2	80·0	86·6	93·0	82·3	83·5	88·0	88·2
Stockton	71·5	74·0	79·5	83·0	91·5	77·3	72·0	75·0	82·0	88·0	77·5	83·0	84·0	84·0
Norwich	80·0	73·0	81·0	88·0	88·0	81·8	83·5	77·5	89·0	92·2	78·0	81·5	88·2	86·0
Leicester	70·9	69·8	74·0	82·0	88·8	75·0	75·8	77·0	84·1	87·0	76·2	79·8	83·5	82·0
Wolverhampton	69·6	68·9	73·0	81·2	87·7	76·4	72·2	73·8	82·3	81·8	66·7	78·3	79·9	70·6
Birmingham	72·2	73·0	—	—	—	77·6	74·0	78·5	83·8	86·2	74·4	—	—	—
Nottingham	76·3	77·6	78·6	90·3	91·6	81·7	81·0	78·8	88·9	89·7	77·3	91·6	86·4	84·9
Holkham	69·6	77·5	68·6	78·4	83·8	68·8	78·3	76·5	74·8	82·7	87·3	68·7	74·5	84·6
Llandudno	63·7	60·7	71·3	74·8	72·7	70·0	67·4	71·5	73·0	71·9	64·0	70·6	66·5	64·0
Sheffield	70·0	72·0	78·0	82·0	85·0	73·0	73·0	76·0	83·0	82·0	69·0	74·0	80·0	70·0
Liverpool	62·7	65·3	71·1	76·2	84·2	66·0	69·1	60·8	67·2	66·0	75·5	66·0	70·8	73·0
Bolton	65·4	64·3	70·3	75·5	83·2	74·1	68·8	69·3	79·4	78·3	64·0	71·2	68·7	65·9
Bermerside	57·2	59·0	58·2	60·0	61·0	53·3	55·7	60·0	59·2	64·0	63·0	62·4	69·0	64·5
Hull	72·0	74·0	73·0	85·0	83·0	79·0	76·0	74·0	84·0	83·0	74·0	76·0	80·0	78·0
Stonyhurst	65·0	66·0	70·8	74·2	83·2	75·0	70·0	68·1	75·9	78·9	74·0	71·1	68·8	68·3
Bradford	64·2	69·0	71·0	80·0	83·3	77·3	71·0	71·2	81·0	70·3	71·0	72·0	71·2	67·7
Leeds	66·0	70·0	80·0	82·0	87·0	76·0	74·0	73·0	83·0	79·0	73·0	74·0	75·0	72·0
Lancaster	55·0	73·0	65·0	62·0	82·0	79·0	66·0	67·0	63·0	66·0	64·0	66·0	69·0	63·0
Cockermouth	63·9	63·0	62·1	63·2	78·0	65·8	67·2	68·3	68·0	66·5	64·9	61·5	66·8	66·8
Silloth	64·7	64·9	64·8	61·9	75·0	66·5	66·9	67·4	66·3	66·8	68·5	62·6	69·0	68·0
Sunderland	71·0	77·0	76·0	77·0	80·0	86·0	75·0	82·0	91·0	90·0	70·0	73·0	75·0	67·0
Carlisle	66·2	67·3	66·8	68·3	78·7	67·5	75·2	70·3	71·0	73·8	71·3	66·3	65·8	72·0
Bywell	66·0	72·0	69·0	68·0	70·0	65·0	67·0	66·0	70·0	78·0	75·0	70·0	68·0	72·0

On the 16th extremes were Osborne 92°·1; Salisbury 87°·5, and Holkam 87°·3; while at Llandudno, Bolton, and Lancaster the highest temperature reached was 64°; on the 17th the extremes were 91°·6 at Nottingham, and 66° at Lancaster; on the 18th, the highest were 90°·2 at Greenwich, and 90°·3 at Somerleyton, and Bywell 68°, and at Bolton 68°·7; and on the 19th the extremes were 92° at Salisbury, and 64° at Llandudno.

It will be seen that, whilst Midland stations in July were enjoying almost tropical heat, those stations situated south of Salisbury and North of Nottingham were experiencing very much lower temperatures.

The mean temperature of the air for July was 65°·4, being 3°·8 and 3°·3 above the average of 110 years and 40 years respectively; it was 3°·7 and 7°·3 higher than in 1880 and 1879 respectively.

The mean temperature of the air for August was 59°·1, being 1°·8 and 2°·4 below the average of 110 years and 40 years respectively; it was 3°·7 and 0°·8 lower than in 1880 and 1879 respectively.

The mean temperature of the air for September was 55°·4, being 1°·2 and 1°·8 lower than the average of 110 years, and 40 years respectively; it was 4°·3 and 0°·9 lower than in 1880 and 1879 respectively.

The mean temperature for the quarter was 60°·0, being 0°·3 above the average of 110 years, and 0°·3 below the average of 40 years.

The mean high day temperature of the air in July was 77°·7, being 3°·5 above the average of 40 years; in August it was 69°·8, being 3°·1 below the average, and in September was 64·5°, being 3°·1 below the average.

The mean low night temperature of the air in July was 54°·9, being 1°·7 above the average of 40 years; in August it was 51°·5, being 1°·8 below the average, and in September 48°·7, being 0°·5 below the average; therefore both the days and nights were warm in July, and both were cold in August and September.

1881. Months.	Temperature of Air. Mean.	Air. Diff. from average of 110 years.	Air. Diff. from average of 40 years.	Evaporation. Mean.	Evaporation. Diff. from average of 40 years.	Dew Point. Mean.	Dew Point. Diff. from average of 40 years.	Air—Daily Range. Mean.	Air—Daily Range. Diff. from average of 40 years.	Elastic Force of Vapour. Mean.	Elastic Force of Vapour. Diff. from average of 40 years.	Weight of Vapour in a Cubic Foot of Air. Mean.	Weight of Vapour in a Cubic Foot of Air. Diff. from average of 40 years.
	°	°	°	°	°	°	°	°	°	in.	in.	grs.	gr.
July -	65·4	+3·8	+3·3	59·7	+2·0	55·0	+1·0	22·8	+1·8	·444	+0·026	4·8	+0·1
Aug. -	59·1	−1·8	−2·4	56·5	−1·0	54·2	+0·2	18·2	−1·5	·421	+0·001	4·7	+0·1
Sept. -	55·4	−1·2	−1·8	53·8	−0·2	53·3	+1·2	15·8	−2·6	·393	+0·013	4·4	+0·1
Means -	60·0	+0·3	−0·3	57·0	+0·3	53·8	+0·8	18·9	−0·8	·419	+0·013	4·6	+0·1

1881. Months.	Degree of Humidity. Mean.	Degree of Humidity. Diff. from average of 40 years.	Reading of Barometer. Mean.	Reading of Barometer. Diff. from average of 40 years.	Weight of a Cubic Foot of Air. Mean.	Weight of a Cubic Foot of Air. Diff. from average of 40 years.	Rain. Amount.	Rain. Diff. from average of 66 years.	Daily Horizontal movement of the Air.	Reading of Thermometer on Grass. Number of Nights it was At or below 30°.	Between 30° and 40°.	Above 40°.	Lowest Reading at Night.	Highest Reading at Night.
			in.	in.	grs.	grs.	in.	in.	Miles.				°	°
July -	89	− 6	29·823	+0·027	535	− 3	2·13	−0·44	249	0	1	30	36·8	78·1
Aug. -	90	+ 3	29·676	−0·108	551	+ 3	3·88	+1·45	302	0	3	28	37·1	53·8
Sept. -	89	+ 8	29·801	−0·004	535	+ 3	2·18	−0·26	186	1	9	20	31·7	52·0
Means -	79	+ 2	29·767	−0·028	530	+ 1	Sum 8·19	Sum +0·75	Mean 246	Sum 1	Sum 13	Sum 78	Lowest 31·7	Highest 53·1

NOTE.—In reading this table it will be borne in mind that the plus sign (+) signifies *above* the average, and that the minus sign (−) signifies *below* the average.

The average duration of the different directions of the wind referred to eight points of the compass, and the duration of each direction in each month in the quarter, were as follow:—

Direction of Wind.	July. 1881.	July. Average.	July. Departure from Average.	August. 1881.	August. Average.	August. Departure from Average.	September. 1881.	September. Average.	September. Departure from Average.
	d.	d.	d.	d.	d.	d.	d.	d.	d.
N.W.	5	2·8	+2·2	2·3	2·3	0·0	11·	2·0	+9·0
N.	1	2·8	−2·8	0·5	3·4	−2·9	6·5	4·0	+2·5
N.E.	1	4·1	−3·1	1·0	3·4	−2·4	2·	5·9	−3·9
E.	0·5	1·3	−0·8	0·5	1·5	−1·0	0·	2·4	−2·4
S.E.	1	0·7	+0·3	2·	1·7	+0·3	0·	2·2	−2·2
S.	2·5	3·0	−0·5	1·3	3·5	−2·2	3·75	2·5	+1·25
S.W.	1·3	11·0	+2·0	1·3	10·8	+2·1	5·5	7·9	−2·4
W.	7	4·3	+2·7	10·4	4·3	+6·1	1·25	3·1	−1·85

The sign (+) denotes excesses over averages; in July the largest numbers with a (+) sign are those opposite to W., N.W., and S.W.; in August opposite W. and S.W.; and in September opposite to N.W.

The sign (−) denotes deficiences below averages. In July the largest numbers are opposite N. and N.E.; in August opposite to N. and N.E.; and in September to N.E.

The mean temperature of the air in July was higher than in June by 7°·7; in August lower than in July by 6°·3, and in September lower than in August by 3°·7.

(From the preceding 40 years observations the increase of temperature from June to July is 3°·3; the decrease from July to August is 0°·7, and from August to September is 4°·3).

From June to July at stations south of latitude 53°, there was an increase of mean temperature of 6°, and north of that parallel an increase of 3¼°; from July to August, at stations south of 51° and north of 53°, there was a decrease of 2°·5; but at stations between 51° and 53° there was a decrease of mean temperature of 5°; and to September there was a further decrease of 2° generally.

Near London the mean daily pressure of the atmosphere till July 18th was above the average by 0·10 in.; from the 19th to the 26th it was below by 0·10 in.; then for three days it was above by 0·144 in. daily; it was 0·177 in. below daily till August 1st; then for five days it averaged an excess daily of 0·229 in. daily; from August 8th till September 12th the barometer reading was low, and for the 35 days ending September 12th, there was an average daily deficiency of 0·188 in., this was followed by four days of a slight excess of pressure, and then by six days of an average deficiency of 0·263 in.; from the 28th to the 30th, the barometer reading was 0·289 in. an excess daily of its average.

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1881.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat^{n}. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Amount of Ozone.	Amount of Cloud.	Rain.	
								Mean						In a cubic foot of Air.						Estimated Strength.	Relative Proportion of						Number of Days it fell.	Amount collected.
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.			Maximum in Rays of Sun.	Minimum on Grass.		N.	E.	S.	W.				
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in.
RUGBY (Warwickshire), Stockton, The Rectory, Rev. W. Tuckwell.	239	July	29·547	0·888	91·5	35·0	56·5	78·4	46·3	27·1	59·3	53·7	·411	4·7	1·0	82	526	—	—	0·4	4	2	14	11	—	—	—	—
		Aug.	29·463	0·858	81·0	37·0	44·0	66·4	47·0	19·4	55·2	52·1	·390	4·4	0·5	90	529	—	—	0·4	6	2	10	13	—	—	—	—
		Sept.	29·563	0·908	75·0	31·0	44·0	63·6	46·1	17·5	53·8	52·4	·394	4·4	0·2	94	532	—	—	0·3	11	6	4	9	0·3	6·5	—	—
LOWESTOFT (Suffolk), S. H. Miller, Esq., F.R.A.S., F.M.S.	89	July	29·867	0·802	87·0	43·6	43·4	70·8	54·0	16·8	61·8	52·2	·391	4·4	1·8	71	530	119·3	50·3	0·6	6	3	6	16	—	6·0	11	1·19
		Aug.	29·699	0·939	75·7	41·5	34·2	65·1	51·0	14·1	58·5	51·5	·381	4·2	1·4	76	530	111·7	48·4	0·9	5	2	7	17	—	6·7	18	3·87
		Sept.	29·865	0·947	66·0	37·7	28·3	61·1	50·1	11·0	53·1	50·0	·361	4·0	0·9	83	537	99·8	46·8	0·5	11	8	6	5	—	6·6	19	2·06
SOMERLEYTON (Suffolk), The Rectory, Rev. C. J. Steward, F.M.S.	50	July	29·910	0·860	90·3	42·6	47·7	73·9	53·4	20·5	61·1	54·9	·432	4·8	1·2	80	531	—	—	1·1	5	4	8	14	5·8	4·7	11	1·21
		Aug.	29·749	0·954	81·3	42·3	39·0	66·5	51·0	15·5	57·0	52·9	·388	4·3	0·9	83	532	—	—	1·0	5	2	9	15	6·3	6·7	17	3·88
		Sept.	29·853	0·902	69·6	37·1	32·5	62·0	49·8	12·2	54·8	51·8	·386	4·4	0·6	90	537	—	—	0·9	11	5	7	7	6·3	6·5	22	2·76
WOLVERHAMPTON (Staffordshire), Wrottesley, E. Simpson, Esq.	500	July	29·404	0·872	87·7	42·5	45·2	70·0	52·4	17·6	59·7	50·1	·364	4·1	1·7	70	524	—	—	—	4	1	11	15	—	7·5	11	1·40
		Aug.	29·243	0·996	81·3	44·3	37·0	63·8	49·4	14·4	55·1	49·4	·354	4·0	0·9	81	524	—	—	—	3	4	10	14	—	8·6	17	4·47
		Sept.	29·413	0·954	67·8	39·8	28·0	60·0	47·6	12·4	52·8	48·8	·351	3·8	0·6	87	531	—	—	—	9	4	6	11	—	7·6	16	1·76
LEICESTER (Town Museum), W. J. Harrison, Esq., F.G.S.	238	July	29·633	0·846	87·0	43·0	44·0	72·6	53·4	19·2	61·9	51·5	·381	4·1	1·4	69	527	127·1	45·5	1·5	6	1	9	15	—	5·5	13	1·36
		Aug.	29·561	0·970	82·0	41·0	41·0	65·5	49·3	16·0	57·6	48·4	·341	3·8	1·5	72	529	111·1	45·0	0·9	5	2	10	14	—	8·8	18	5·17
		Sept.	29·699	0·938	73·6	37·3	36·1	62·7	48·0	14·7	54·3	48·6	·342	3·9	0·9	89	535	106·3	39·0	0·6	10	6	7	7	—	6·1	18	2·40
NOTTINGHAM (Notts), M.O. Tarbotton, Esq., C.E., F.G.S., F.M.S.	183	July	29·746	0·832	91·6	41·0	50·6	75·2	52·9	22·3	62·4	52·9	·403	4·5	1·8	71	526	122·6	49·7	0·3	3	1	10	17	0·9	5·4	12	1·69
		May	29·580	1·026	81·0	38·0	45·0	67·1	48·6	18·5	56·7	49·6	·335	4·0	1·2	77	530	108·4	44·6	0·3	5	4	8	14	1·5	7·1	26	4·38
		Sept.	29·760	0·966	73·2	37·2	36·0	61·4	45·6	15·8	53·7	50·0	·360	4·1	0·6	87	536	90·8	45·8	0·2	13	4	6	7	0·2	7·1	22	1·84
HOLKHAM (Norfolk), John Davidson, Esq., Assistant to the Earl of Leicester.	39	April	29·912	0·526	65·2	25·3	39·9	50·5	34·8	15·7	42·2	37·3	·223	2·6	0·5	84	552	105·9	27·8	2·0	10	9	9	2	—	6·2	11	0·87
		May	30·026	1·346	68·2	24·2	44·0	60·8	40·2	20·6	50·0	42·2	·275	3·1	1·0	75	546	119·9	24·5	1·6	9	7	10	5	—	4·6	9	0·62
		June	29·905	0·750	77·7	34·3	43·4	66·4	45·8	20·6	55·3	47·5	·330	3·8	1·2	75	537	123·3	40·0	1·4	10	2	12	6	—	6·4	9	1·43
		July	29·849	0·884	87·3	40·4	46·9	72·5	51·4	21·1	61·2	52·4	·394	4·4	1·7	74	539	137·4	44·3	1·6	7	2	12	9	—	5·8	11	1·50
		Aug.	29·730	0·972	85·0	40·0	46·0	68·1	47·8	18·6	56·5	50·7	·371	4·1	0·8	81	533	113·5	40·9	1·5	6	1	14	10	—	7·3	—	3·44
		Sept.	29·896	0·944	69·2	35·2	34·0	60·7	45·2	15·5	53·0	50·6	·369	4·1	0·1	91	539	92·1	40·0	1·2	10	3	11	6	—	7·1	17	3·37
LLANDUDNO (Carnarvonshire), James Nicol, Esq., M.D.	197	July	29·847	1·000	74·8	47·6	27·2	65·3	54·4	10·9	58·5	53·6	·403	4·5	1·0	82	534	—	—	0·8	5	1	4	21	—	5·8	12	3·41
		Aug.	29·682	1·180	72·2	45·7	26·5	61·9	52·5	9·4	56·3	49·4	·354	4·0	1·1	77	532	—	—	0·9	3	4	2	22	—	6·8	20	4·92
		Sept.	29·866	1·030	64·4	46·2	18·2	59·2	51·1	8·8	55·3	49·8	·339	4·0	0·9	82	537	—	—	0·7	5	3	4	12	—	6·6	15	0·98
LIVERPOOL, The Observatory, John Hartnup, Esq., F.R.A.S.	197	July	29·734	0·952	84·2	49·7	34·5	66·3	54·5	11·8	58·8	51·2	·375	4·2	1·3	76	530	—	—	1·2	2	0	6	23	—	6·8	16	2·08
		Aug.	29·565	1·070	77·0	46·0	31·0	62·3	52·3	10·0	55·8	50·2	·345	4·1	0·9	82	531	—	—	1·4	3	4	7	17	—	8·0	22	4·98
		Sept.	29·765	0·987	66·6	45·3	21·3	59·7	50·4	9·3	51·2	49·0	·348	4·0	0·8	82	536	—	—	0·8	8	7	4	11	—	7·3	11	1·67
BOLTON, Sharples (Lancashire), Rev. T. Mackereth, F.R.A.S., F.M.S.	500	July	29·407	0·910	83·2	42·7	40·5	66·2	51·0	15·2	58·8	51·8	·385	4·3	0·9	85	526	82·6	44·8	1·1	5	1	9	16	3·7	7·6	22	6·44
		Aug.	29·241	1·141	77·3	41·1	36·2	61·3	48·6	12·7	55·8	48·7	·342	3·9	0·7	82	527	74·8	42·0	1·1	5	3	8	15	3·1	7·6	26	7·26
		Sept.	29·444	1·085	65·7	40·2	25·5	60·4	47·4	13·0	52·8	47·6	·330	3·7	0·8	82	532	74·0	40·6	0·2	8	7	7	8	2·2	7·2	17	2·62
HALIFAX, Bermerside Observatory (Yorkshire), E. J. Crossley, Esq., F.R.A.S.	530	July	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	29·248	1·146	81·7	42·7	39·0	63·7	48·8	14·8	54·2	49·8	·358	4·0	0·7	85	526	90·3	47·3	0·9	2	5	10	14	—	7·8	22	5·84
		Sept.	29·456	0·932	69·5	39·0	30·5	59·5	45·5	14·0	51·9	48·3	·339	3·8	0·6	87	533	92·3	45·2	0·7	6	7	7	10	—	7·4	14	2·90
HULL (Yorkshire), The People's Park, Mr. E. Peake.	12	July	29·913	0·868	84·0	40·0	44·0	71·7	52·4	19·3	61·4	53·2	·405	4·5	1·6	75	531	99·9	50·4	1·4	4	2	5	20	—	5·9	14	2·75
		Aug.	29·734	1·088	83·0	42·0	40·0	65·1	48·3	16·8	56·1	50·3	·346	4·1	0·9	81	533	86·6	46·2	1·6	8	1	2	20	—	6·2	25	6·45
		Sept.	29·951	0·922	71·0	37·0	34·0	61·8	47·8	14·0	54·6	49·7	·356	4·0	0·8	83	539	81·2	44·0	1·0	3	10	11	6	—	6·9	17	3·31
STONYHURST (Lancashire), Rev. S. J. Perry, F.R.S., F.M.S., F.R.A.S.	363	July	29·549	0·831	83·2	41·9	41·3	67·6	50·1	17·5	58·8	52·8	·401	4·4	0·7	86	529	120·2	50·4	—	1	0	7	23	—	8·0	20	5·82
		Aug.	29·369	1·139	75·0	40·1	34·9	63·5	48·4	15·1	54·7	49·6	·355	4·0	0·9	82	528	110·5	47·2	—	4	1	7	19	—	8·7	22	6·22
		Sept.	29·594	0·992	68·1	37·1	31·0	63·0	47·2	15·8	53·5	47·6	·330	3·8	0·9	80	534	107·2	45·4	—	7	8	3	12	—	7·6	16	2·16

NAMES of STATIONS and OBSERVERS.	Height of Sl above Sea Leve	Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Mean Daily Range.	Mean Air.	Mean Dew Point.	Elastic Force.	Mean Humidity.	Mean Amount of Cloud in tenths of the Sky.	Mean Amount of Rain in tenths of the Sky.	Number of Days on which Rain fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.			in.	
BRADFORD (Yorkshire), J. McLandsborough, Esq., C.E., F.G.S.	266	July	29·735	0·624	86·3	46·2	40·1	76·5	54·3	14·2	59·8	50·8	·371	4·1	1·6	·72	16	3·27
		Aug.	29·750	1·218	79·6	40·6	38·6	62·6	31·6	11·7	53·6	49·0	·340	3·9	1·1	·79	23	3·15
		Sept.	29·573	0·924	67·1	43·0	24·1	59·3	34·8	11·5	51·7	48·0	·331	3·8	1·1	·85	19	3·11
LEEDS (Yorkshire), The Philosophical Hall, HENRY CROWTHER, Esq.	137	July	29·774	0·930	87·0	45·0	42·0	72·6	54·1	18·5	62·0	58·7	·424	4·8	1·7	·89	11	2·15
		Aug.	29·804	1·092	83·0	43·0	40·0	68·4	50·7	15·7	57·5	53·7	·385	4·3	1·6	·80	21	3·71
		Sept.	29·819	0·911	71·0	42·0	29·0	61·6	40·4	11·2	54·3	50·3	·355	4·1	1·6	·86	19	2·23
LANCASTER (Southfields), WILLIAM ROPER, Esq.	114	July	29·791	0·936	86·0	44·0	42·0	69·0	52·1	13·3	60·8	55·4	·394	4·4	1·7	·85	20	6·33
		Aug.	29·804	1·154	82·0	43·0	39·0	68·3	50·6	12·7	55·0	50·5	·363	4·1	1·6	·83	20	5·80
		Sept.	29·683	1·140	80·0	38·0	42·0	62·3	40·1	14·2	54·1	48·6	·333	3·9	1·5	·82	13	1·72
COCKERMOUTH (Cumberland), H. Dodgson, Esq., M.D., F.M.S., F.R.A.S.	146	July	29·415	0·856	78·2	45·9	32·3	64·1	52·7	11·4	56·8	52·8	·391	4·3	1·5	·85	20	3·83
		Aug.	29·397	1·226	69·9	40·4	29·5	61·6	40·4	11·4	54·8	50·8	·346	3·9	1·3	·80	20	4·71
		Sept.	29·289	0·980	65·4	38·0	27·4	61·3	38·2	11·1	54·0	48·2	·337	3·8	1·3	·82	9	1·64
SILLOTH (Cumberland), "The Rectory," Rev. F. REDFORD, M.A., F.R.A.S., F.M.S.	33	July	29·854	0·767	75·0	44·0	31·0	64·8	51·9	12·9	57·3	50·4	·358	4·1	1·2	·77	19	2·97
		Aug.	29·713	1·472	68·5	39·0	29·5	62·2	39·0	12·2	54·9	49·2	·340	3·9	1·0	·85	21	5·92
		Sept.	29·940	0·986	66·6	38·3	28·3	61·2	37·6	12·6	53·8	48·1	·336	3·8	0·8	·82	12	3·28
CARLISLE, Spital (Cumberland), ISAAC CARTMEL, Esq., F.M.S.	111	July	29·763	0·812	78·7	50·2	29·5	67·0	53·7	13·3	57·6	53·5	·395	4·4	1·1	·83	17	3·50
		Aug.	29·694	1·228	73·2	47·8	25·4	63·0	46·6	16·0	55·4	51·2	·375	4·2	0·8	·83	24	6·68
		Sept.	29·647	0·912	69·8	38·4	30·4	62·3	37·4	14·9	53·2	48·6	·344	3·9	0·7	·85	11	1·92
BYWELL (Northumberland), Mr. W. J. TOSE, Assistant to W. E. BEAUMONT, Esq., M.P.	87	July	29·777	0·986	78·0	49·0	29·0	70·6	54·5	16·1	59·9	56·4	·451	5·0	0·8	·89	10	2·66
		Aug.	29·814	0·958	66·0	45·0	21·0	60·7	50·5	10·2	51·6	—	—	—	—	—	1	3·97
		Sept.															19	4·51

NAMES of STATIONS and OBSERVERS.	Relative Proportion of N.	E.	S.	W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Number of Days on which Rain fell.	Amount collected.
								in.
BRADFORD (Yorkshire), J. McLandsborough, Esq., C.E., F.G.S.	6	2	7	19	—	6·1	16	3·27
	6	6	6	16	—	7·0	23	3·15
	6	9	9	10	—	5·8	19	3·11
LEEDS (Yorkshire), The Philosophical Hall, HENRY CROWTHER, Esq.	—	—	—	—	—	—	11	2·15
	4	3	5	21	—	6·3	21	3·71
	5	7	5	15	—	6·7	19	2·23
LANCASTER (Southfields), WILLIAM ROPER, Esq.	—	—	—	—	—	—	20	6·33
	—	—	—	—	—	—	20	5·80
	—	—	—	—	—	—	13	1·72
COCKERMOUTH (Cumberland), H. Dodgson, Esq., M.D., F.M.S., F.R.A.S.	6	4	10	19	1·5	8·6	20	3·83
	4	7	5	17	2·3	7·2	20	4·71
	5	7	8	10	0·7	7·1	9	1·64
SILLOTH (Cumberland), "The Rectory," Rev. F. REDFORD, M.A., F.R.A.S., F.M.S.	—	—	—	—	—	—	19	2·97
	—	—	—	—	—	—	21	5·92
	—	—	—	—	—	—	12	3·28
CARLISLE, Spital (Cumberland), ISAAC CARTMEL, Esq., F.M.S.	4	1	5	23	3·9	8·3	17	3·50
	3	7	4	16	3·1	8·0	24	6·68
	5	14	4	7	2·2	7·4	11	1·92
BYWELL (Northumberland), Mr. W. J. TOSE, Assistant to W. E. BEAUMONT, Esq., M.P.	5	0	4	22	—	7·0	10	2·66
	4	20	3	3	—	8·7	19	4·51

NAMES of STATIONS and OBSERVERS.	Height of Sl above Sea Leve	Months.	Mean Pressure of dry Air reduced to the level of the Sea.	Mean Temperature of Air.	Mean Dew Point.	Mean Elastic Force of Vapour.	Mean Humidity.	Mean Amount of Cloud.	Mean Amount of Rain.	Number of Days on which Rain fell.	Amount collected.
	feet.		in.	°	°	in.					in.
Guernsey	30	July	29·753	63·8	57·8	·427	82	5·4	·2	7	0·55
		Aug.	29·750	62·6	56·6	·410	84	5·3	·2	8	0·70
		Sept.	29·573	58·7	52·7	·370	83	5·2	·2	8	0·57
Truro	250	July	29·774	61·0	55·0	·402	84	5·4	·2	7	0·47
		Aug.	29·804	60·0	54·0	·390	84	5·3	·2	8	0·54
		Sept.	29·819	56·8	51·0	·360	85	5·2	·2	8	0·49
Plymouth	100	July	29·791	61·0	55·0	·394	83	5·3	·2	7	0·47
		Aug.	29·804	60·0	54·0	·382	83	5·2	·2	8	0·54
		Sept.	29·683	56·8	51·0	·350	83	5·1	·2	8	0·49
Totnes	100	July	29·415	61·0	55·0	·394	84	5·4	·2	7	0·47
		Aug.	29·397	60·0	54·0	·382	84	5·3	·2	8	0·54
		Sept.	29·289	56·8	51·0	·350	83	5·2	·2	8	0·49
Babbacombe	100	July	29·854	61·0	55·0	·394	84	5·4	·2	7	0·47
		Aug.	29·713	60·0	54·0	·382	84	5·3	·2	8	0·54
		Sept.	29·940	56·8	51·0	·350	83	5·2	·2	8	0·49
Ventnor	100	July	29·763	61·0	55·0	·394	84	5·4	·2	7	0·47
		Aug.	29·694	60·0	54·0	·382	84	5·3	·2	8	0·54
		Sept.	29·647	56·8	51·0	·350	83	5·2	·2	8	0·49
Eastbourne	100	July	29·777	61·0	55·0	·394	84	5·4	·2	7	0·47
		Aug.	29·814	60·0	54·0	·382	84	5·3	·2	8	0·54
		Sept.	29·814	56·8	51·0	·350	83	5·2	·2	8	0·49

NAMES of STATIONS.	Mean Pressure of dry Air reduced to the level of the Sea.	Mean Temperature of Air.	Mean Dew Point.	Mean Elastic Force of Vapour.	Mean Humidity.	Mean Amount of Cloud.	Mean Amount of Rain.	Number of Days on which Rain fell.	Amount collected.
	in.	°	°	in.					in.
Guernsey	29·554	63·8	57·8	·427	82	5·4	·2	7	0·55
Truro	29·547	61·0	55·0	·394	84	5·4	·2	7	0·47
Plymouth	29·648	61·0	55·0	·394	83	5·3	·2	7	0·47
Totnes	29·717	61·0	55·0	·394	84	5·4	·2	7	0·47
Babbacombe	29·592	61·0	55·0	·394	84	5·4	·2	7	0·47
Ventnor	29·605	61·0	55·0	·394	84	5·4	·2	7	0·47
Eastbourne	29·448	61·0	55·0	·394	84	5·4	·2	7	0·47
Osborne	29·538	61·0	55·0	·394	84	5·4	·2	7	0·47
Southbourne	29·572	61·0	55·0	·394	84	5·4	·2	7	0·47
Salisbury	29·537	61·0	55·0	·394	84	5·4	·2	7	0·47
Barnstaple	29·514	61·0	55·0	·394	84	5·4	·2	7	0·47
Ramsgate	29·525	61·0	55·0	·394	84	5·4	·2	7	0·47
Caterham	—	61·0	55·0	·394	84	5·4	·2	7	0·47
Bath	29·550	61·0	55·0	·394	84	5·4	·2	7	0·47
Strathfield Turgiss	29·557	61·0	55·0	·394	84	5·4	·2	7	0·47
Marlborough	29·576	61·0	55·0	·394	84	5·4	·2	7	0·47
Blackheath	29·542	61·0	55·0	·394	84	5·4	·2	7	0·47
Whitchurch	—	61·0	55·0	·394	84	5·4	·2	7	0·47
Camden Square	29·550	61·0	55·0	·394	84	5·4	·2	7	0·47
Barnet	—	61·0	55·0	·394	84	5·4	·2	7	0·47
Oxford	29·546	61·0	55·0	·394	84	5·4	·2	7	0·47
Gloucester	29·541	61·0	55·0	·394	84	5·4	·2	7	0·47
Royston	29·571	61·0	55·0	·394	84	5·4	·2	7	0·47
Cardington	29·501	61·0	55·0	·394	84	5·4	·2	7	0·47
Cambridge	29·102	61·0	55·0	·394	84	5·4	·2	7	0·47
Stockton near Rugby	29·459	61·0	55·0	·394	84	5·4	·2	7	0·47
Lowestoft	29·529	61·0	55·0	·394	84	5·4	·2	7	0·47
Somerleyton	29·478	61·0	55·0	·394	84	5·4	·2	7	0·47
Wolverhampton	29·543	61·0	55·0	·394	84	5·4	·2	7	0·47
Leicester	29·553	61·0	55·0	·394	84	5·4	·2	7	0·47
Nottingham	29·521	61·0	55·0	·394	84	5·4	·2	7	0·47
Holkham	29·502	61·0	55·0	·394	84	5·4	·2	7	0·47
Llandudno	29·638	61·0	55·0	·394	84	5·4	·2	7	0·47
Liverpool	29·538	61·0	55·0	·394	84	5·4	·2	7	0·47
Bolton	29·553	61·0	55·0	·394	84	5·4	·2	7	0·47
Hull	29·508	61·0	55·0	·394	84	5·4	·2	7	0·47
Stonyhurst	29·551	61·0	55·0	·394	84	5·4	·2	7	0·47
Bradford	29·521	61·0	55·0	·394	84	5·4	·2	7	0·47
Leeds	29·464	61·0	55·0	·394	84	5·4	·2	7	0·47
Lancaster	29·478	61·0	55·0	·394	84	5·4	·2	7	0·47
Cockermouth	29·414	61·0	55·0	·394	84	5·4	·2	7	0·47
Silloth	29·511	61·0	55·0	·394	84	5·4	·2	7	0·47
Carlisle	29·501	61·0	55·0	·394	84	5·4	·2	7	0·47
Bywell	—	61·0	55·0	·394	84	5·4	·2	7	0·47

PARALLELS OF LATITUDE, &c.	Mean Pressure of dry Air reduced to the level
	in.
Guernsey	29·5
Between the latitudes 50° and 51°	29·5
Between the latitudes 51° and 52°	29·5
Between the latitudes 52° and 53°	29·5
Between the latitudes 53° and 54°	29·5
Between the latitudes 54° and 55°	29·5
Mean for the Quarter, 50° to 55°	Year 1878 29·5
	" 1879 29·5
	" 1880 29·5
	" 1881 29·5

The highest tempe
The lowest temper
The greatest daily
The least daily ra
The greatest num
The least number
The greatest fall
The least falls of

4°·8 below the
r than in 1880

5°·3 above the
er than in 1880

erature exceeded

the average and
wer than in 1880

ge of 110 years,

elow the average
and in December

4°·5 below the
nd in December
cold in October

D

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1881.	Months.	Pressure of Atmosphere in Month.			Temperature of Air in Month.					Mean Temperature.	Vapour.			Mean Weight of a cubic foot of Air.	Mean Degree of Humidity. Sat^{n}. = 100.	Wind.				Mean Reading of Thermometer.		Estimated Strength.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
				Mean.	Range.		Highest.	Lowest.	Range.	Mean Of all Highest.	Mean Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	In a cubic foot of Air.	Short of Saturation.	Mean.	N.	E.	S.	W.	Maximum in Rays of Sun.	Minimum on Grass.				Number of Days it fell.	Amount fallen.
	feet.			in.	in.		°	°	°	°	°	°	°	°	in.	grs.	grs.												in.
RUGBY (Warwickshire), Stockton, The Reetory, Rev. W. TUCKWELL.	339	July	29·547	0·888	91·5	35·0	56·5	78·4	40·3	27·1	52·7	52·7	·411	4·7	1·0	82	526	4	14	11	11	—	—	5·8	7·8	11	2·21
		Aug.	29·483	0·858	81·0	37·0	44·0	60·4	47·0	10·4	52·1	52·1	·399	4·4	0·5	90	529	6	10	13	4	—	—	6·3	7·6	15	3·81
		Sept.	29·465	0·908	73·0	31·0	44·0	63·6	46·1	17·5	53·8	53·4	·394	4·4	0·2	94	532	11	6	4	9	—	—	6·3	7·6	15	—
LOWESTOFT (Suffolk), S. H. MILLER, Esq., F.R.A.S., F.M.S.	80	July	29·967	0·892	87·0	43·6	54·0	70·9	43·4	16·8	61·8	59·2	·391	4·4	1·8	71	530	3	24	16	16	119·3	50·3	0·6	8·0	11	1·19
		Aug.	29·939	0·939	75·7	41·5	51·0	64·2	51·5	12·7	58·6	57·5	·384	4·2	1·4	76	530	2	28	17	6	111·7	48·4	0·9	6·7	18	3·87
		Sept.	29·965	0·947	66·0	37·7	49·3	61·1	50·1	11·0	55·1	50·0	·361	4·0	0·9	83	537	11	8	5	5	99·8	46·8	0·5	6·6	19	2·93
SOMERLEYTON : (Suffolk), The Rector, Rev. C. J. STEWARD, F.M.S.	50	July	29·910	0·860	90·3	43·6	47·7	73·9	53·4	20·5	64·9	64·9	·433	4·8	1·2	80	531	5	8	14	11	—	—	1·1	4·7	11	1·21
		Aug.	29·749	0·864	81·3	42·3	39·0	66·5	51·0	15·5	57·0	57·0	·388	4·3	0·9	83	532	2	25	15	5	—	—	1·0	6·3	17	2·88
		Sept.	29·853	0·902	69·6	37·1	52·5	62·0	49·8	12·2	54·8	51·8	·366	4·4	0·6	90	537	11	5	7	7	—	—	0·9	6·3	22	2·76
WOLVERHAMPTON (Staffordshire), Wrottesley, E. SIMPSON, Esq.	500	July	29·404	0·872	87·7	45·2	70·0	52·4	17·6	69·7	50·1	·364	4·1	1·7	70	524	—	—	—	—	—	—	—	—	—	7·5	11	1·49
		Aug.	29·243	0·905	81·3	44·5	57·0	71·4	49·4	14·4	55·1	49·4	·354	4·0	0·9	81	521	—	—	—	—	—	—	—	—	—	8·6	17	4·47
		Sept.	29·413	0·954	67·8	39·8	49·0	61·0	47·6	13·4	52·8	49·8	·351	3·8	0·6	87	531	—	—	—	—	—	—	—	—	—	7·6	16	1·76
LEICESTER (Town Museum), W. J. HARRISON, Esq., F.G.S.	238	July	29·603	0·846	87·0	43·0	44·0	72·6	57·4	19·2	61·0	61·0	·391	4·1	1·4	69	527	6	15	15	15	127·1	45·5	1·5	5·5	13	1·30
		Aug.	29·561	0·870	82·0	41·0	41·0	65·5	49·5	16·0	57·6	48·4	·341	3·8	1·5	73	529	10	7	7	7	111·1	47·0	0·9	6·1	14	2·17
		Sept.	29·609	0·958	73·6	37·5	36·1	62·7	48·0	14·7	54·3	49·6	·342	3·9	0·9	89	535	10	3	6	10	106·3	44·0	0·6	6·1	18	2·40
NOTTINGHAM (Notts), M. O. TARBOTTON, Esq., C.E., F.G.S., F.M.S.	183	July	29·726	0·833	91·6	41·0	50·6	75·2	52·9	23·3	62·4	62·9	·403	4·5	1·8	71	526	3	1	4	17	122·6	49·7	0·3	5·4	19	1·69
		Aug.	29·580	1·005	81·0	39·0	45·9	67·1	48·6	15·8	56·7	49·6	·333	4·0	1·2	77	530	4	4	6	11	109·4	44·6	0·3	7·1	26	4·30
		Sept.	29·760	0·966	73·2	37·2	38·0	61·4	45·6	12·8	53·7	50·0	·360	4·1	0·6	87	535	13	4	5	11	90·8	45·8	0·2	7·1	22	1·81
HOLKHAM (Norfolk), JOHN DAVIDSON, Esq., Assistant to the Earl of Leicester.	89	April	29·912	0·526	85·2	25·3	39·9	59·5	34·8	13·7	42·2	37·3	·223	2·6	0·5	81	552	10	9	9	2	103·9	37·8	3·0	4·6	11	0·97
		May	29·958	0·746	90·2	34·2	44·0	69·6	40·2	20·6	50·0	43·2	·275	3·1	1·0	75	547	10	7	2	6	119·8	34·5	1·6	6·4	9	1·65
		June	29·965	0·750	77·3	34·3	41·4	69·1	45·8	23·3	53·8	47·5	·290	3·6	1·2	74	537	12	2	9	6	123·8	41·8	1·4	5·8	11	1·55
		July	29·940	0·784	80·0	40·0	40·4	69·0	47·1	19·1	61·2	52·4	·344	4·1	1·7	74	539	3	11	5	10	137·5	44·8	1·6	7·3	11	2·44
		Aug.	29·753	0·672	86·0	40·0	46·0	69·1	47·8	18·6	58·5	50·7	·371	4·1	0·8	81	530	5	11	11	10	122·1	40·0	1·2	7·1	17	3·97
		Sept.	29·896	0·914	65·2	33·0	36·0	60·7	45·2	13·5	53·0	49·0	·359	4·0	0·1	91	541	4	2	1	1	—	—	0·8	5·8	13	3·41
LLANDUDNO (Carnarvonshire), JAMES NICOL, Esq., M.D.	197	July	29·847	1·000	74·8	47·6	57·2	62·3	54·4	10·9	58·5	53·0	·403	4·5	1·0	82	534	5	1	4	21	—	—	0·8	5·8	13	4·02
		Aug.	29·682	1·140	72·2	45·7	56·5	61·9	52·5	9·4	56·3	49·4	·354	4·0	1·1	77	532	3	2	5	22	—	—	0·9	6·0	20	4·92
		Sept.	29·766	1·050	64·4	46·2	48·2	59·9	51·1	8·8	55·3	49·8	·350	4·0	0·9	82	537	5	4	2	12	—	—	0·7	6·6	13	0·98
LIVERPOOL, The Observatory, JOHN HARTNUP, Esq., F.R.A.S.	197	July	29·734	0·952	84·2	49·7	54·5	68·3	54·5	11·8	58·8	51·2	·375	4·1	1·3	76	530	4	3	2	23	—	—	1·2	6·8	10	2·08
		Aug.	29·565	1·079	77·0	45·3	51·9	62·3	52·3	10·0	55·8	51·2	·365	4·1	0·9	82	531	2	4	7	17	—	—	1·4	6·0	11	4·08
		Sept.	29·765	0·987	66·0	41·3	51·3	59·7	50·4	9·3	54·0	49·0	·348	4·0	0·8	82	536	2	7	4	11	—	—	0·8	7·3	11	1·07
BOLTON, Sharples (Lancashire), Rev. T. MACKERETH, F.R.A.S., F.M.S.	500	July	29·407	0·910	83·2	49·7	49·5	69·2	51·0	13·2	58·8	51·8	·335	4·3	0·9	85	526	1	3	1	10	126·6	44·8	1·1	5·7	23	6·44
		Aug.	29·244	1·141	77·3	41·1	50·2	61·3	48·6	12·7	55·8	48·7	·342	3·9	0·7	82	527	5	5	3	15	124·0	42·0	1·4	5·1	26	7·65
		Sept.	29·441	1·065	65·7	40·2	25·3	59·4	47·4	13·0	52·8	47·6	·330	3·7	0·8	82	532	7	8	2	8	94·0	40·6	0·2	5·2	17	2·03
HALIFAX, Bermerside Observatory (Yorkshire), E. J. CROSSLEY, Esq., F.R.A.S.	539	July	29·246	1·146	81·7	42·7	39·0	59·8	46·8	14·8	51·6	48·3	·253	4·0	0·7	85	526	2	5	14	14	—	—	1·1	7·8	22	3·54
		Aug.	29·456	0·952	69·3	39·0	29·5	58·5	43·5	14·0	51·0	48·3	·239	3·8	0·8	87	533	10	7	10	10	92·3	43·2	0·7	7·4	14	2·90
HULL (Yorkshire), The People's Park, Mr. E. PEASE.	12	July	29·913	0·866	84·0	40·0	44·0	71·7	52·1	19·3	61·4	57·2	·405	4·5	1·6	75	531	5	5	5	20	99·9	39·4	1·4	5·9	14	2·75
		Aug.	29·735	1·088	83·0	42·0	40·5	65·1	46·3	16·8	56·1	51·3	·360	4·1	0·9	81	523	4	1	4	20	96·2	42·2	1·6	6·2	15	3·45
		Sept.	29·951	0·923	71·0	37·0	34·0	61·8	47·8	14·0	54·0	49·7	·356	3·9	0·8	83	530	10	2	11	6	94·0	41·2	1·0	6·9	17	3·31
STONYHURST (Lancashire), Rev. S. J. PERRY, F.R.S., F.M.S., F.L.S.A.	353	July	29·510	0·831	81·2	41·9	41·3	67·8	50·1	17·3	58·8	52·6	·401	4·4	0·7	86	529	—	1	7	23	120·2	39·4	—	5·7	20	5·82
		Aug.	29·359	1·159	73·0	40·2	34·9	64·5	44·4	15·1	54·7	49·6	·355	4·1	0·9	82	526	1	4	7	19	110·5	37·8	—	6·7	22	6·22
		Sept.	29·394	0·932	66·1	37·1	31·0	62·0	47·2	14·8	53·5	47·0	·330	3·8	0·9	80	534	—	1	7	12	106·2	43·4	—	7·6	16	2·15

Meteorological Table, Quarter ending December 31st, 1881.

NAMES of STATIONS and OBSERVERS.	Height of Sta. above Mean Sea Level.	Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Mean Daily Range.	Air.	Dew Point.	Relative Humidity.	Mean.	Mean Duration of Sunshine.	Mean Weight of cubic Foot of Air.	Maximum in Days of Sun.	Minimum on Grass.	Estimated Strength.	Relative Proportion of N.	E.	S.	W.	Mean Amount Ozone.	Mean Amount Cloud.	Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	°	grs.	hrs.	grs.										in.	in.
BRADFORD (Yorkshire), J. McLandsborough, Esq., C.E., F.G.S.	536	July	29·731	0·631	82·2	44·0	38·2	85·5	36·4	14·2	57·1	50·4	77	4·1	1·2	304	100·0	48·2	1·5			1	19			19	3·97
		Aug.	29·750	1·218	82·0	43·6	38·4	83·6	34·6	13·7	53·6	49·6	85	3·9	0·9	309	106·7	46·3	1·3			10	14			23	3·75
		Sept.	29·573	0·921	84·1	43·0	41·1	85·0	33·0	13·9	54·0	48·3	82	3·9	0·9	305	109·0	44·0	1·1				9			19	3·11
LEEDS (Yorkshire), The Philosophical Hall, HENRY CROWTHER, Esq.	137	July	29·774	0·910	82·0	43·0	39·0	83·0	37·0	13·5	57·0	52·0	80	4·0	0·7	298	100·3	46·3	1·2			5	21		3·3	11	2·15
		Aug.	29·594	1·092	82·0	45·0	37·0	83·0	37·0	13·2	57·6	52·6	85	4·3	0·9	330	109·8	46·4	1·3			5	15			21	3·71
		Sept.	29·619	0·911	81·0	42·0	39·0	82·0	36·0	13·9	54·8	50·8	86	4·1	0·6	305	108·9	43·4	0·8				10		6·		19	2·58
LANCASTER (Southfields), WILLIAM ROPER, Esq.	111	July	29·730	0·926	82·0	44·0	38·0	83·0	36·0	13·5	57·3	52·4	85	4·4	0·7	323										20	0·89
		Aug.	29·584	1·184	82·0	39·0	43·0	83·0	36·0	12·7	55·0	50·6	85	4·1	0·8	332										22	0·89
		Sept.	29·655	1·190	80·0	38·0	42·0	82·0	33·0	14·9	54·1	49·3	82	3·9	0·8	327										12	1·72
COCKERMOUTH (Cumberland), H. Dodgson, Esq., M.D., F.M.S., F.R.A.S.	146	July	29·415	0·926	78·2	42·9	35·3	81·6	34·1	13·7	57·1	51·9	85	4·5	0·8	327	100·3	48·0	1·0			10	5			20	3·33
		Aug.	29·737	1·356	80·9	40·4	40·5	81·8	30·4	13·1	54·8	50·4	87	4·4	0·9	337	108·8	46·4	0·5				9		7·9	20	4·71
		Sept.	29·529	0·990	83·4	38·0	45·4	84·2	32·0	13·2	54·0	48·2	82	3·9	0·9	327	108·9	43·4	0·3				9			9	1·64
SILLOTH (Cumberland), "The Rectory," Rev. F. REDFORD, M.A., F.R.A.S., F.M.S.	25	July	29·874	0·907	75·0	44·0	31·0	64·8	31·0	11·2	57·3	50·4	77	4·1	1·2	324	100·9	48·3	1·5			1	20			20	2·97
		Aug.	29·715	1·472	68·5	39·0	29·5	62·2	29·3	10·3	54·9	49·2	85	3·7	0·9	353	107·7	46·3	1·3			10	14			21	5·33
		Sept.	29·910	0·986	66·6	38·3	28·3	61·2	29·6	9·1	53·6	49·1	86	3·6	0·8	336	109·0	44·0	1·1				9			12	2·65
CARLISLE, Spital (Cumberland), ISAAC CARTMELL, Esq., F.M.S.	111	July	29·763	0·812	78·7	39·2	39·5	67·0	37·6	11·7	57·6	51·5	85	4·4	1·1	332	100·3	46·3	1·2			22				17	3·60
		Aug.	29·606	1·228	73·2	37·8	35·4	65·2	37·4	10·6	55·4	51·2	89	4·2	1·0	331	109·8	43·1	1·0			16				24	3·65
		Sept.	29·647	0·913	68·8	38·4	30·4	62·3	33·4	9·3	54·2	49·6	87	3·9	0·7	338	109·6	41·2	0·5				14		3·2	11	1·92
BYWELL (Northumberland), Mr. W. J. Tosh, Agent to W. B. Beaumont, Esq., M.P.	87	July	29·777	0·936	78·0	40·0	38·0	70·6	34·6	10·1	57·0	52·0	89	4·0	0·8	329		45·7	1·0				22		7·0	10	2·60
		Aug.	29·614	0·958	66·0	40·0	26·0	60·7	30·3	9·1	54·6	50·4	89	3·9	0·7	344		43·0	1·0			20	5		8·7	15	2·97
		Sept.	29·814	0·988	66·0	45·0	11·0	60·7	30·3	10·2	54·6	50·4	87	3·9	0·8	341		45·0	1·0				5		8·7	19	4·91

NAMES OF STATIONS.	Mean Pressure of dry Air reduced to the level of the Sea.
	in.
Guernsey - - -	29·554
Truro - - - -	29·547
Plymouth - - -	29·643
Totnes - - - -	29·717
Babbacombe - - -	29·592
Ventnor - - - -	29·605
Eastbourne - - -	29·448
Osborne - - - -	29·538
Southbourne - - -	29·572
Salisbury - - - -	29·553
Barnstaple - - -	29·544
Ramsgate - - - -	29·525
Caterham - - - -	—
Bath - - - - -	29·560
Strathfield Turgiss - -	29·535
Marlborough - - -	29·576
Blackheath - - -	29·542
Whitechurch - - -	—
Camden Square - -	29·550
Barnet - - - - -	—
Oxford - - - - -	29·546
Gloucester - - -	29·541
Royston - - - -	29·571
Cardington - - -	29·501
Cambridge - - - -	29·492
Stockton near Rugby -	29·439
Lowestoft - - - -	29·529
Somerleyton - - -	29·478
Wolverhampton - -	29·542
Leicester - - - -	29·559
Nottingham - - -	29·521
Holkham - - - -	29·502
Llandudno - - - -	29·639
Liverpool - - - -	29·538
Bolton - - - - -	29·553
Hull - - - - -	29·509
Stonyhurst - - - -	29·554
Bradford - - - -	29·521
Leeds - - - - -	29·464
Lancaster - - - -	29·478
Cockermouth - - -	29·414
Silloth - - - - -	29·510
Carlisle - - - -	29·502
Bywell - - - - -	—

The highest tempe 4°·8 below the
The lowest temper r than in 1880
The greatest daily
The least daily ra
The greatest numl
The least number
The greatest fall
The least falls of

QUART

PARALLELS OF LATITUDE, &c.	Mean Pressure of dry Air reduced to the level
Guernsey - - -	29·
Between the latitudes 50° and 51°	29·
Between the latitudes 51° and 52°	29·
Between the latitudes 52° and 53°	29·
Between the latitudes 53° and 54°	29·
Between the latitudes 54° and 55°	29·
Mean for the Quarter, 50° to 55° Year 1878	29·
Mean for the Quarter, 50° to 55° " 1879	29·
Mean for the Quarter, 50° to 55° " 1880	29·
Mean for the Quarter, 50° to 55° " 1881	29·

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wer than in 1880
rage of 110 years,
elow the average
and in December
cold in October

4°·5 below the

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orological Tables, Quarter ending September 30th, 1881.

Temperature of Air in Month. — Mean Temperature. — Vapour. — Mean of Highest. — Mean of Lowest. — Range. — Mean. — In a cubic foot of Air. — Tension. — Weight of a cubic foot of Air. — Degree of Humidity. — Saturn. — Sun. — Mean Reading of Thermometer. — Wind. — Relative Proportion of — N. — E. — S. — W. — Mean Amount of Ozone. — Mean Amount of Cloud. — Rain. — Mean Amount of Rain. — Number of Days on which fell. — Mean Amount of Snow. — Number of Days on which fell. — Mean Amount of Sunshine. — Number of Hours Sun Shone. — Mean Amount of Fog. — Number of Days on which Observed. — Year 1881. — Mean Pressure of Atmosphere in Month. — Mean of all Highest Readings of the Thermometer. — Mean of all Lowest Readings of the Thermometer. — Mean Range of Temperature in the Quarter. — Mean of all Highest. — Mean of all Lowest. — Mean Monthly Range of Temperature. — Mean Daily Range of Temperature. — Mean Temperature of the Air. — Mean Temperature of the Dew Point. — Mean Elastic Force of Vapour. — Mean Weight of Vapour in a cubic foot of Air. — Mean additional Weight required for saturation. — Mean degree of Humidity. — Mean Weight of a cubic foot of Air. — Mean Reading of Maximum in Rays of Sun. — Mean Reading of Minimum on Grass. — Mean Estimated Strength. — Mean Amount of Ozone. — Mean Amount of Cloud.

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METEOROLOGY OF ENGLAND,

DURING THE QUARTER ENDING DECEMBER 31, 1881.

REMARKS ON THE WEATHER DURING THE QUARTER ENDING DECEMBER 31ST, 1881.

By JAMES GLAISHER, ESQ., F.R.S., *&c.*

The weather in October was cold, and at times painfully so, with winds for the most part from S.E., E., and N.E. The month proved to be the coldest October about London for 64 years, although the October of the year 1842 was nearly as cold. On the 13th the barometer reading decreased rapidly, and the wind blew heavily from the north-west, increasing in strength during the night, to a very violent gale on the morning of the 14th. On this day great damage was done. About London, slates, tiles, buildings in course of construction were blown down in great numbers. Large trees were uprooted, and during the morning locomotion was difficult and dangerous. The gale extended all over the country, many thousands of large trees being blown down; there was loss of life at many places, and great damage to property everywhere both on land and sea. The month was almost free from thunderstorms, and but little lightning was seen; snow fell on the 15th at Wrottesley, and at this time the mountains in Wales were white with snow, as also were those in Cumberland at the end of the month.

The month of November was fine and warm being a great contrast to that of October; the prevalent winds were from the W., S.W., and S. and there was almost a total absence of north and north-west winds. The mean temperature of the month at Greenwich was 48°·7, being 3°·4 warmer than in October, and warmer than in any November back to 1852 which was 48°·9. In the year 1818 the mean temperature of November was 49°·2 being the warmest November on record, and there was no other instance back to 1771 of so warm a November as this.

The weather in December for the first week was cloudy and generally warm; from the 8th to the 25th it was cold, with frequent fog, at times dense; on the 26th it became warmer, and continued so to the end of the year. The weather throughout the month was open. The range of readings of the barometer was great, being as large as 1″·5 at southern stations, increasing to 1″·8 and 1″·9 at northern stations. There was a good deal of fog at stations in the Midland counties.

About London the mean daily temperature of the air, with very slight exceptions, was below its average till November 3rd; the mean daily defect of temperature for these 34 days was 4°·8, the very cold days being October 5th with a temperature 11° below its average, October 16th, with 11°·1 below its average, and October 30th, 31st, and November 1st, with 11°·8, 12°·6, and 11°·9 respectively below their averages. On November 4th a warm period set in and continued to December 7th, a period like the preceding, of 34 days in length, whose mean excess of daily temperature was 5°·4; of these, November 5th, 11th, 12th, 13th were 11°·4, 10°, 11°·1, and 10°·7 above their averages. From December 8th to December 25th, the temperature was mostly cold; the average daily deficiency of these 18 days was 2°·6, and the average daily excess of temperature from December 26th to the end of the year was 4°·8.

The mean temperature of the air for October was 45°·3, being 3°·5 and 4°·8 below the average of 110 years and 40 years respectively; it was 0°·9 and 3°·8 lower than in 1880 and 1879 respectively.

Back to 1771 there have been but five Octobers so cold as this, viz.:

In 1782	the mean temperature was	45°·2
1784	„	43°·9
1786	„	44°·7
1817	„	45°·0
1842	„	45°·4
1881	„	45°·3

The mean temperature of the air for November was 48°·7, being 6°·4 and 5°·3 above the average of 110 years and 40 years respectively; it was 6°·2 and 10°·4 higher than in 1880 and 1879 respectively.

Back to the year 1771 there have been but three Novembers whose mean temperature exceeded 48°, the instances are:

1818	when it was	49°·2
1822	„	48°·2
1852	„	48°·9
1881	„	48°·7

The mean temperature of the air for December was 39°·8, being 0°·8 above the average and 0°·1 below the average of 110 years and 40 years respectively; it was 3°·4 lower than in 1880 and 7°·4 higher than in 1879.

The mean temperature of the quarter was 44°·6, being 1°·2 above the average of 110 years, and 0°·1 above the average of 40 years.

The mean high day temperature of the air in October was 52°·4, being 5°·8 below the average of 40 years; in November it was 54°·0, being 5°·3 higher than the average, and in December was 43°·9, being 0°·8 below the average.

The mean low night temperature of the air in October was 39°·0, being 4°·5 below the average of 40 years; in November it was 42°·8, being 5°·6 above the average, and in December was 34°·9, being 0°·3 below the average; therefore both the days and nights were cold in October and December, and were very warm in November.

MONTHLY METEOROLOGICAL TABLE FOR THE QUARTER ENDING SEPTEMBER 30TH, 1881.

The Observations have been reduced to Mean values by Glaisher's Barometrical and Diurnal Range Tables, and the Hygrometrical results have been deduced from the sixth edition of his Hygrometrical Tables.

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1881. Months.	Pressure of Atmosphere in Month. Mean.	Pressure of Atmosphere in Month. Range.	Temperature of Air in Month. Highest.	Lowest.	Range.	Mean Highest.	Mean Lowest.	Mean Daily Range.	Mean Temperature. Air.	Mean Temperature. Dew Point.	Vapour. Elastic Force.	Vapour. In a cubic foot of Air. Mean.	Vapour. In a cubic foot of Air. Short of Saturation.	Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer. Maximum in Rays of Sun.	Mean Reading of Thermometer. Minimum on Grass.	Wind. Estimated Strength.	Wind. Relative Proportion of N.	Wind. Relative Proportion of E.	Wind. Relative Proportion of S.	Wind. Relative Proportion of W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days it fell.	Rain. Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									
GUERNSEY, Adolphus Collenette, Esq., F.M.S.	270	July	29·777	0·687	83·0	47·5	35·5	69·6	54·5	15·1	60·4	55·5	·445	5·0	0·9	85	529	117·6	49·8	1·2	8	4	7	12	3·3	3·0	15	1·72
		Aug.	29·642	0·790	80·0	50·0	30·0	65·9	54·8	11·1	59·1	56·1	·451	5·1	0·2	91	528	115·1	50·0	1·6	3	4	10	14	4·6	4·7	23	4·83
		Sept.	29·705	0·931	72·0	46·0	26·0	63·2	52·8	10·4	56·9	55·0	·433	4·7	0·3	93	532	110·2	46·5	1·1	7	8	5	10	4·4	4·3	22	2·06
TRURO (Cornwall), C. Barham, Esq., M.D., F.M.S.	43	July	29·972	0·904	83·0	37·0	46·0	70·8	53·8	17·0	59·8	53·5	·409	4·5	1·2	80	533	—	—	2·1	10	2	6	13	—	6·5	11	2·69
		Aug.	29·813	0·849	76·0	41·0	35·0	66·9	53·0	13·9	58·6	51·8	·355	4·3	1·2	77	532	—	—	2·5	6	1	9	15	—	7·0	18	3·55
		Sept.	29·889	1·001	70·0	36·0	34·0	66·3	46·9	19·4	55·5	50·4	·359	4·1	0·8	83	537	—	—	1·9	7	6	9	8	—	5·9	11	1·91
PLYMOUTH (Devon), J. Merrifield, Esq., LL.D., F.R.A.S., F.M.S.	69	July	30·045	0·835	82·0	45·0	37·0	69·6	55·0	14·6	61·2	54·5	·420	4·8	1·3	79	533	—	—	1·4	6	3	8	14	—	5·7	13	2·26
		Aug.	29·891	0·869	71·7	44·3	27·2	65·4	53·5	11·9	58·5	54·2	·420	4·7	0·8	85	533	—	—	1·5	7	4	5	15	—	7·4	20	3·25
		Sept.	29·981	1·013	68·6	42·5	24·1	62·8	48·5	14·3	55·1	50·6	·370	4·1	0·8	85	539	—	—	1·0	8	6	8	8	—	4·6	11	2·63
TOTNES (Devon), T. H. Edmonds, Esq.	107	July	30·043	0·852	87·5	37·3	50·2	72·4	51·4	21·0	61·2	52·8	·400	4·5	1·6	75	533	129·8	45·8	1·0	6	2	9	14	—	4·8	12	2·61
		Aug.	29·894	0·894	77·2	43·3	33·9	67·0	51·5	15·5	58·2	52·1	·390	4·4	1·1	80	534	121·5	46·1	2·7	5	1	7	18	—	6·3	17	5·49
		Sept.	29·995	1·031	74·8	35·3	39·5	65·8	44·3	21·5	54·8	48·2	·335	3·8	1·0	78	539	118·2	40·1	—	6	5	11	8	—	4·8	15	3·69
TORQUAY, Babbacombe (Devon), Edwin E. Glyde, Esq., F.M.S.	305	July	29·718	0·864	82·8	45·9	36·9	70·7	53·2	17·5	60·5	53·1	·403	4·5	1·4	76	528	146·9	45·0	1·1	7	5	5	14	3·9	5·5	11	1·46
		Aug.	29·566	0·910	77·7	45·8	31·9	65·9	51·9	14·0	57·8	52·0	·388	4·3	1·0	81	529	132·5	45·1	1·4	4	3	7	17	5·6	6·8	18	4·79
		Sept.	29·664	1·093	72·4	43·3	29·1	63·6	49·2	14·4	55·8	49·6	·356	4·0	1·0	80	532	126·9	40·8	0·9	8	7	7	8	3·7	5·4	12	2·09
VENTNOR, (Isle of Wight) (Royal National Hospital for Consumption), J. Codling, Esq.	150	July	29·943	0·736	81·9	49·9	32·0	70·9	56·0	14·9	61·7	56·1	·452	4·7	1·4	72	531	—	—	—	3	2	10	16	5·6	4·6	13	1·41
		Aug.	29·801	0·862	74·8	48·5	26·3	65·4	53·9	11·5	58·5	54·8	·432	4·8	0·7	87	532	—	—	—	4	2	9	16	5·9	6·5	21	4·17
		Sept.	29·884	0·962	70·9	48·0	23·2	64·0	53·4	10·6	57·6	53·3	·406	4·5	0·8	85	534	—	—	—	9	7	4	10	—	5·8	15	1·89
EASTBOURNE (Sussex), Miss W. L. Hall.	12	July	29·954	0·754	85·3	43·5	41·8	74·6	54·5	20·1	63·3	56·4	·475	5·0	1·5	78	529	134·3	42·2	0·3	4	1	9	17	1·6	—	10	1·97
		Aug.	29·810	0·890	77·0	48·5	28·2	71·2	53·7	17·5	60·9	58·7	·462	5·1	0·9	87	529	120·0	47·2	0·5	6	1	6	18	4·0	—	18	4·22
		Sept.	29·902	0·900	70·3	39·7	30·6	65·9	49·7	16·2	57·2	54·5	·426	4·7	0·6	91	535	110·8	43·8	0·1	9	4	8	9	0·9	—	19	2·12
OSBORNE (Isle of Wight), J. R. Mann, Esq.	172	July	29·886	0·806	95·6	44·3	51·3	76·9	55·2	21·7	64·5	57·0	·466	5·1	1·6	77	526	126·8	52·5	0·3	4	1	10	16	—	4·3	11	1·44
		Aug.	29·700	0·844	82·1	44·2	37·9	67·9	53·3	14·6	58·5	54·4	·426	4·7	0·8	86	530	112·7	51·3	0·2	5	1	12	13	—	6·4	15	4·76
		Sept.	29·806	0·914	75·1	46·0	29·1	65·9	51·0	14·9	56·6	54·0	·417	4·7	0·4	91	534	109·3	48·1	0·2	11	4	6	9	—	5·7	11	1·81
SOUTHBOURNE ON SEA (Herts), T. A. Campton, Esq., M.D., B.A., F.M.S.	95	April	29·752	1·054	65·6	27·7	37·9	53·6	38·6	15·0	45·1	37·0	·220	2·5	0·8	73	546	—	—	1·5	10	10	4	6	—	6·1	7	0·41
		May	30·005	0·592	72·8	31·0	41·8	60·8	44·1	16·7	51·9	45·5	·308	3·5	0·9	79	543	—	—	1·2	6	9	7	9	—	4·3	8	0·97
		June	29·888	0·744	75·0	40·5	34·5	61·9	49·4	12·5	54·7	48·6	·342	3·9	0·9	79	538	—	—	1·1	6	3	11	10	—	5·9	14	1·36
		July	29·916	0·812	80·4	40·5	39·9	70·0	53·4	16·6	60·6	53·0	·402	4·5	1·4	76	532	—	—	1·0	5	2	10	14	—	4·1	11	1·09
		Aug.	29·782	0·888	70·2	42·6	27·6	64·7	53·1	11·6	58·0	52·3	·396	4·4	1·0	81	532	—	—	1·3	4	2	8	17	—	5·9	20	4·17
		Sept.	29·875	0·962	68·9	42·8	26·1	63·0	49·4	13·6	55·6	50·5	·372	4·1	0·8	84	536	—	—	0·8	13	4	4	9	—	4·8	7	1·68
SALISBURY (Wilton House), Wilts, Thomas Challis, Esq.	186	July	29·818	0·886	93·5	33·0	60·5	78·0	49·1	28·9	62·7	57·1	·468	5·2	1·1	82	527	122·9	45·5	1·8	8	0	4	19	—	5·5	12	2·05
		Aug.	29·658	0·894	83·0	36·0	47·0	69·0	53·2	15·8	58·7	51·4	·379	4·2	1·3	76	529	108·3	42·8	1·1	7	1	7	16	—	7·5	22	6·46
		Sept.	29·777	0·974	78·0	32·5	45·5	67·9	44·3	23·6	55·0	49·9	·359	4·0	0·9	83	535	106·6	40·2	1·1	9	6	5	10	—	6·2	13	1·82
BARNSTAPLE (Devon), William Knill, Esq.	48	July	29·987	0·900	87·0	34·0	53·0	72·1	52·4	19·7	60·7	52·9	·401	4·5	1·4	75	533	—	—	1·2	1	0	10	20	—	3·7	5	1·83
		Aug.	29·813	0·890	79·0	44·0	35·0	67·5	56·3	11·2	59·9	54·8	·430	4·8	1·0	84	530	—	—	1·3	3	1	12	15	—	5·5	22	5·00
		Sept.	29·914	0·980	69·0	39·0	30·0	65·6	51·2	14·4	57·2	52·4	·393	4·4	0·9	84	535	—	—	1·1	8	4	7	11	—	3·6	14	2·31

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1881.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat^{n}. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.					Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a Cubic foot of Air.						Estimated Strength.	Relative Proportion of						Number of Days it fell.	Amount collected.
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.			Maximum in Rays of Sun.	Minimum on Grass.		N.	E.	S.	W.				
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in.
RAMSGATE (Kent), Rev. T. E. Egan, O.S.B.	108	July	29·923	0·838	84·7	45·5	39·2	74·1	58·7	15·4	63·2	57·3	·469	5·2	1·3	81	529	—	—	1·1	5	4	8	14	—	5·7	10	0·98
		Aug.	29·752	0·887	74·7	48·1	26·6	66·8	53·2	13·6	59·0	55·4	·439	4·9	0·7	88	530	—	—	1·4	4	2	9	16	—	5·1	19	3·70
		Sept.	29·861	0·898	70·7	47·5	23·2	63·5	52·7	10·8	57·3	53·1	·404	4·5	0·8	86	534	—	—	0·9	7	4	6	13	—	6·9	17	2·72
CATERHAM (Surrey), Metropolitan Asylum, G. Stanley Elliot, Esq., M.D.	607	July	—	—	90·0	38·0	52·0	—	—	—	65·2	57·5	·475	5·3	1·6	77	—	—	—	1·0	7	1	4	19	—	4·3	12	2·37
		Aug.	—	—	—	—	—	—	—	—	56·0	53·1	·405	4·5	0·4	90	—	—	—	0·8	6	2	5	18	—	4·5	17	2·83
		Sept.	29·364	0·800	70·0	36·0	34·0	65·0	47·0	18·0	54·9	49·8	·355	4·0	0·9	82	528	—	—	1·1	10	10	6	4	—	3·5	17	3·06
STRATHFIELD TURGISS (Hants), Rev. C. H. Griffith, M.A., F.M.S.	197	July	29·765	0·834	93·3	37·2	56·1	76·3	51·8	24·5	63·5	53·4	·409	4·6	1·7	70	527	125·5	45·4	1·2	5	1	6	19	3·8	4·8	10	1·37
		Aug.	29·635	0·852	81·3	37·8	44·5	67·5	46·5	21·0	56·2	52·3	·394	4·4	0·6	87	531	113·0	41·9	1·4	2	1	12	16	2·8	6·5	17	5·37
		Sept.	29·771	0·953	74·1	38·5	35·8	64·4	45·7	18·7	54·3	50·1	·362	4·1	0·6	86	536	111·1	41·1	0·8	9	3	7	11	1·5	5·9	12	1·66
BATH (Somerset), St. Gregory's College, Downside, Rev. T. J. Almond, O.S.B., F.M.S.	596	July	29·373	0·865	83·8	44·9	38·9	69·0	52·8	16·2	59·2	55·0	·431	4·9	0·8	86	523	122·5	53·9	1·5	3	1	8	19	—	6·3	13	3·71
		Aug.	29·206	0·850	75·3	43·2	32·1	63·0	49·2	13·1	55·4	51·0	·374	4·2	0·7	85	524	111·4	46·8	1·4	5	2	9	15	—	6·9	21	7·96
		Sept.	29·338	1·007	70·0	41·5	28·5	61·9	47·5	14·4	53·9	49·0	·347	3·0	0·8	83	528	111·0	44·4	1·0	8	4	6	12	—	5·9	7	2·12
MARLBOROUGH (Wilts), Rev. Thomas A. Preston, M.A., F.M.S.	456	July	29·508	0·834	87·1	36·2	50·9	73·2	52·1	21·1	61·4	52·7	·398	4·4	1·7	74	524	126·2	44·6	0·8	5	1	6	19	—	5·6	13	2·14
		Aug.	29·351	0·922	80·1	39·1	41·0	65·3	49·1	16·2	56·4	50·0	·362	4·0	1·0	79	526	113·1	43·5	0·6	7	2	13	9	—	5·5	20	6·23
		Sept.	29·480	0·968	74·7	37·0	37·7	63·0	46·9	16·1	54·1	48·8	·345	3·9	0·8	82	531	108·9	41·7	0·4	12	2	6	10	—	6·2	12	1·84
BLACKHEATH (Kent), James Glaisher, Esq., F.R.S.	160	July	29·823	0·850	94·0	45·5	48·5	76·0	56·0	20·0	64·5	55·9	·448	5·0	1·8	73	526	127·6	51·1	1·1	4	2	9	16	—	5·2	11	2·16
		Aug.	29·686	0·881	84·3	45·0	39·3	67·6	52·3	15·3	58·4	51·2	·378	4·2	1·3	77	530	106·2	48·0	1·3	2	2	9	18	—	7·1	18	4·64
		Sept.	29·802	0·961	71·0	41·0	30·0	63·1	50·0	13·1	53·3	51·2	·378	4·3	0·7	87	535	97·4	46·5	0·9	13	1	7	9	—	7·3	17	2·40
WHITCHURCH RECTORY (Oxon), (near Reading). Rev. J. Slatter, M.A., F.R.S., F.M.S.	150	July	29·855	0·785	91·3	36·8	54·5	76·7	54·9	21·8	64·5	57·0	·466	5·1	1·6	77	526	—	—	1·0	4	1	11	15	—	4·9	12	1·93
		Aug.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Sept.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
CAMDEN SQUARE (London), G. J. Symons, Esq., F.R.S., F.M.S.	123	July	29·860	0·749	94·6	44·3	50·3	77·9	55·8	22·1	65·2	52·8	·400	4·4	2·5	64	526	119·8	52·0	—	7	2	9	13	—	4·6	14	1·85
		Aug.	29·713	0·909	84·6	42·3	42·3	69·3	51·3	18·0	59·1	51·3	·379	4·3	1·3	76	530	110·6	47·7	—	6	2	6	17	—	5·5	19	4·89
		Sept.	29·841	0·960	75·7	41·7	32·0	65·4	49·7	15·7	54·8	52·0	·383	4·3	0·5	88	536	100·9	46·5	—	16	4	4	6	—	6·7	11	2·03
BARNET (Gas Works), T. H. Martin, Esq., C.E.	212	July	—	—	92·5	34·5	58·0	75·4	51·9	23·5	62·5	57·1	·467	5·2	1·2	82	527	—	—	—	—	—	—	—	—	—	11	1·81
		Aug.	—	—	83·9	35·0	48·9	68·0	49·3	18·7	57·2	54·2	·420	4·7	0·6	89	530	—	—	—	—	—	—	—	—	—	18	4·76
		Sept.	—	—	77·3	35·9	41·4	64·4	46·2	18·2	54·5	51·9	·387	4·4	1·4	91	536	—	—	—	—	—	—	—	—	—	11	1·94
OXFORD (The Observatory), E. J. Stone, Esq., M.A., F.R.S.	210	July	29·768	0·869	84·9	42·9	44·0	72·8	54·4	18·4	63·4	53·9	·416	4·7	1·8	71	526	124·0	50·8	2·1	4	0	10	17	1·5	5·8	17	2·21
		Aug.	29·613	0·931	80·2	41·5	38·7	66·4	51·4	15·0	58·2	53·6	·408	4·6	0·9	85	529	114·3	47·7	2·5	3	1	13	14	1·6	6·9	21	4·84
		Sept.	29·755	0·985	74·5	36·9	37·6	63·6	47·5	16·1	55·0	50·3	·362	4·1	0·8	85	535	105·8	45·4	1·9	11	5	6	8	0·5	7·6	15	1·30
GLOUCESTER COUNTY ASYLUM, E. Toller, Esq., M.R.C.S., F.M.S.	100	July	29·899	0·952	89·0	40·0	49·0	75·1	52·1	23·0	62·0	54·8	·430	4·7	1·5	77	530	125·2	49·0	1·9	8	1	2	20	0·9	4·7	7	1·03
		Aug.	29·742	0·936	83·0	40·0	43·0	70·3	50·1	20·2	57·6	53·5	·410	4·5	0·7	86	531	101·9	46·2	1·7	6	2	2	21	1·3	6·8	14	3·69
		Sept.	29·639	0·988	75·5	38·0	37·5	66·0	48·3	17·7	55·9	52·0	·391	4·5	0·6	87	536	109·0	44·0	1·2	10	6	4	10	—	5·9	11	1·47
ROYSTON (Hertfordshire), Hale Wortham, Esq., F.R.A.S., F.M.S.	269	July	29·710	0·842	93·0	44·3	48·7	76·4	53·9	22·5	63·2	53·5	·409	4·5	1·8	71	525	—	—	—	3	2	8	18	—	5·4	9	1·76
		Aug.	29·575	0·906	76·0	41·6	34·4	67·5	50·0	17·5	57·0	51·7	·384	4·3	0·9	82	529	—	—	—	4	1	9	17	—	7·4	17	4·61
		Sept.	29·715	0·935	75·3	41·2	32·1	63·2	48·7	14·5	54·0	51·0	·374	4·2	0·5	89	535	—	—	1·2	12	4	4	8	—	6·2	13	1·50
BEDFORD, Cardington, Mr. J. McLaren, Assistant to S. Whitbread, Esq., M.P.	105	July	29·840	0·936	91·6	41·0	50·6	76·6	53·8	22·8	65·0	52·7	·396	4·4	2·4	65	526	119·5	49·9	1·1	5	1	4	21	—	5·6	11	1·90
		Aug.	29·689	0·940	85·0	39·0	46·0	68·4	49·4	19·0	58·9	53·2	·406	4·5	1·1	81	529	104·3	48·4	1·7	5	0	6	20	—	7·0	19	4·72
		Sept.	29·830	0·944	71·0	37·0	34·0	63·4	47·7	15·7	55·0	52·1	·389	4·4	0·6	90	536	87·0	43·9	0·8	10	4	6	10	—	7·3	14	2·00
CAMBRIDGE (Trinity College), J. W. L. Glaisher, Esq., M.A., F.R.S.	40	July	29·913	0·918	93·0	43·0	50·0	78·1	53·8	24·3	64·1	54·0	·419	4·7	1·9	70	528	141·4	46·8	1·0	5	1	9	16	—	4·8	12	1·96
		Aug.	29·749	0·944	87·0	40·4	46·6	70·6	50·3	20·3	58·3	52·4	·395	4·4	1·0	80	531	129·4	45·7	1·1	6	0	11	14	—	7·2	18	5·28
		Sept.	29·907	0·950	76·2	36·0	40·2	66·0	48·4	17·6	55·7	53·2	·407	4·6	0·4	91	536	114·3	43·7	0·8	12	4	9	5	—	6·7	21	1·98

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1881.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.			Mean Degree of Humidity. Sat. = 100.	Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.		Wind.				Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a cubic foot of Air.						Estimated Strength.	Relative Proportion of						
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.			Maximum in Rays of Sun.	Minimum on Grass.		N.	E.	S.	W.			Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								in.
RUGBY (Warwickshire), Stockton, The Rectory, Rev. W. Tuckwell.	289	July	29·547	0·888	81·5	35·0	56·5	73·4	46·3	27·1	59·3	53·7	·411	4·7	1·0	82	526	—	—	0·4	4	2	14	11	—	5·8	11	2·21
		Aug.	29·443	0·858	81·0	37·0	44·0	66·4	47·0	19·4	55·2	52·1	·330	4·4	0·5	89	529	—	—	0·4	6	2	10	13	—	7·8	15	3·81
		Sept.	29·563	0·908	75·0	31·0	44·0	63·6	46·1	17·5	53·8	52·4	·394	4·4	0·2	94	532	—	—	0·3	11	6	4	9	0·3	6·5	—	—
LOWESTOFT (Suffolk), S. H. Miller, Esq., F.R.A.S., F.M.S.	89	July	29·867	0·802	87·0	43·6	43·4	70·8	54·0	16·8	61·8	52·2	·391	4·4	1·8	71	530	119·3	50·3	0·6	6	3	6	16	—	6·0	11	1·19
		Aug.	29·699	0·939	75·7	41·5	34·2	65·1	51·0	14·1	58·5	51·5	·381	4·2	1·4	76	530	111·7	48·4	0·9	5	2	7	17	—	6·7	18	3·87
		Sept.	29·865	0·917	66·0	37·7	28·3	61·1	50·1	11·0	53·1	50·0	·361	4·0	0·9	83	537	99·8	46·8	0·5	11	8	6	5	—	6·6	19	2·06
SOMERLEYTON (Suffolk), The Rectory, Rev. C. J. Steward, F.M.S.	50	July	29·910	0·860	90·3	42·6	47·7	73·9	53·4	20·5	61·1	54·9	·432	4·8	1·2	80	531	—	—	1·1	5	4	8	14	5·8	4·7	11	1·21
		Aug.	29·749	0·954	81·3	42·3	39·0	66·5	51·0	15·5	57·0	52·0	·388	4·3	0·9	83	532	—	—	1·0	5	2	9	15	6·3	6·7	17	3·88
		Sept.	29·853	0·902	69·6	37·1	32·5	62·0	49·8	12·2	54·8	51·8	·360	4·4	0·6	90	537	—	—	0·9	11	5	7	7	6·3	6·5	22	2·76
WOLVERHAMPTON (Staffordshire), Wrottesley, E. Simpson, Esq.	500	July	29·404	0·872	87·7	42·5	45·2	70·0	52·4	17·6	59·7	50·1	·364	4·1	1·7	70	524	—	—	—	4	1	11	15	—	7·5	11	1·49
		Aug.	29·243	0·996	81·3	44·3	37·0	63·8	49·4	14·4	55·1	49·4	·354	4·0	0·9	81	521	—	—	—	3	4	10	14	—	8·6	17	4·47
		Sept.	29·413	0·954	67·8	39·8	28·0	60·0	47·6	12·4	52·8	48·8	·351	3·8	0·6	87	531	—	—	—	9	4	6	11	—	7·6	16	1·76
LEICESTER (Town Museum), W. J. Harrison, Esq., F.G.S.	238	July	29·693	0·846	87·0	43·0	44·0	72·6	53·4	19·2	61·0	51·5	·381	4·1	1·4	69	527	127·1	45·5	1·5	6	1	9	15	—	5·5	13	1·36
		Aug.	29·561	0·970	82·0	41·0	41·0	65·5	49·5	16·0	57·6	48·4	·341	3·8	1·3	72	529	111·1	43·0	0·9	5	2	10	14	—	8·8	18	3·17
		Sept.	29·699	0·958	73·6	37·5	36·1	62·7	48·0	14·7	54·3	48·6	·342	3·9	0·9	80	535	106·3	39·0	0·6	10	6	7	7	—	6·1	18	2·40
NOTTINGHAM (Notts), M.O. Tarbotton, Esq., C.E., F.G.S., F.M.S.	183	July	29·746	0·832	91·6	41·0	50·6	75·2	52·9	22·3	62·4	52·9	·403	4·5	1·8	71	526	122·6	49·7	0·3	3	1	10	17	0·9	5·4	12	1·69
		Aug.	29·589	1·026	87·0	38·0	49·0	67·4	48·6	18·8	58·7	49·6	·335	4·0	1·2	77	540	108·4	44·6	0·3	5	4	8	11	1·5	7·1	26	4·39
		Sept.	29·760	0·966	73·2	37·2	36·0	61·4	45·6	15·8	53·7	50·0	·360	4·1	0·6	87	536	99·8	45·8	0·2	13	4	6	7	0·2	7·1	22	1·84
HOLKHAM (Norfolk), John Davidson, Esq., Assistant to the Earl of Leicester.	39	April	29·912	0·526	65·2	25·3	39·9	50·5	34·8	15·7	42·2	37·3	·223	2·6	0·3	81	552	105·9	27·8	2·0	10	9	9	2	—	6·2	11	0·87
		May	30·026	1·346	68·2	34·2	44·0	60·8	40·2	20·6	50·0	42·2	·275	3·1	1·0	75	545	119·9	34·5	1·6	9	7	10	5	—	4·6	9	0·62
		June	29·905	0·750	77·7	34·3	43·4	69·4	45·8	23·6	53·3	47·5	·330	3·8	1·2	75	537	123·3	40·0	1·4	10	2	12	6	—	6·4	9	1·45
		July	29·850	0·884	87·3	40·4	46·9	72·5	51·4	21·1	61·2	52·4	·394	4·4	1·7	74	530	137·4	44·3	1·6	7	2	12	9	—	5·8	11	1·50
		Aug.	29·730	0·972	86·0	40·0	46·0	69·4	47·8	18·6	56·5	50·7	·371	4·1	0·8	81	533	113·5	40·9	1·5	6	1	11	10	—	7·3	13	3·44
		Sept.	29·896	0·944	69·2	33·2	34·0	60·7	45·2	15·5	53·0	50·6	·369	4·1	0·4	91	539	92·1	40·0	1·2	10	3	11	6	—	7·1	17	3·77
LLANDUDNO (Carnarvonshire), James Nicol, Esq., M.D.	197	July	29·847	1·000	74·8	47·6	27·2	65·3	54·4	10·9	58·5	53·0	·403	4·5	1·0	82	534	—	—	0·8	5	1	4	21	—	5·8	12	3·41
		Aug.	29·682	1·180	72·2	45·7	26·5	61·9	52·5	9·4	56·3	49·4	·354	4·0	1·1	77	532	—	—	0·9	3	4	2	22	—	6·8	20	4·92
		Sept.	29·806	1·030	64·4	46·2	18·2	59·9	51·1	8·8	55·3	49·8	·359	4·0	0·9	82	537	—	—	0·7	5	0	4	12	—	6·6	15	0·98
LIVERPOOL, The Observatory, John Hartnup, Esq., F.R.A.S.	197	July	29·734	0·952	84·2	49·7	34·5	66·3	54·5	11·8	58·8	51·2	·375	4·2	1·3	76	530	—	—	1·2	2	0	6	23	—	6·8	16	2·08
		Aug.	29·565	1·070	77·0	46·0	31·0	62·3	52·3	10·0	55·8	50·2	·365	4·1	0·9	82	531	—	—	1·4	3	4	7	17	—	8·0	22	4·08
		Sept.	29·765	0·987	66·6	45·3	21·3	59·7	50·4	9·3	54·2	49·0	·348	4·0	0·8	82	536	—	—	0·8	8	7	4	11	—	7·3	11	1·67
BOLTON, Sharples (Lancashire), Rev. T. Mackereth, F.R.A.S., F.M.S.	500	July	29·407	0·910	83·2	42·7	40·5	66·2	51·0	15·2	56·8	51·8	·385	4·3	0·9	83	526	82·6	44·8	1·1	5	1	9	16	3·7	7·6	22	6·44
		Aug.	29·244	1·141	77·3	41·1	36·2	61·3	48·6	12·7	53·8	48·7	·342	3·9	0·7	82	527	74·8	42·0	1·1	5	3	8	15	3·1	7·6	26	7·26
		Sept.	29·444	1·005	65·7	40·2	25·5	60·4	47·4	13·0	52·8	47·6	·330	3·7	0·8	82	532	74·0	40·6	3·2	8	7	7	8	2·2	7·2	17	2·62
HALIFAX, Bermerside Observatory (Yorkshire), E. J. Crossley, Esq., F.R.A.S.	530	July	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Aug.	29·248	1·146	81·7	42·7	39·0	63·7	48·8	14·8	54·2	49·8	·358	4·0	0·7	85	526	99·3	47·3	0·9	2	5	10	14	—	7·8	22	5·84
		Sept.	29·456	0·932	69·5	39·0	30·5	59·5	45·5	14·0	51·9	48·5	·339	3·8	0·6	87	533	92·3	45·2	0·7	6	7	7	10	—	7·4	14	2·90
HULL (Yorkshire), The People's Park, Mr. E. Peake.	12	July	29·913	0·808	84·0	40·0	44·0	71·7	52·4	19·3	61·4	53·2	·405	4·5	1·6	75	531	99·9	50·4	1·4	4	2	5	20	—	5·9	14	2·75
		Aug.	29·735	1·088	83·0	43·0	40·0	65·1	48·3	16·8	56·1	50·3	·366	4·1	0·9	81	533	84·6	46·2	1·6	8	1	2	20	—	6·2	23	6·45
		Sept.	29·931	0·922	71·0	37·0	34·0	61·8	47·8	14·0	54·6	49·7	·336	4·0	0·8	83	539	81·2	44·0	1·0	3	10	11	6	—	6·9	17	3·34
STONYHURST (Lancashire), Rev. S. J. Perry, F.R.S., F.M.S., F.R.A.S.	363	July	29·549	0·851	83·2	41·9	41·3	67·6	50·1	17·5	56·8	52·6	·401	4·4	0·7	86	529	120·2	50·4	—	1	0	7	23	—	8·0	20	5·82
		Aug.	29·369	1·159	75·0	40·1	34·9	63·5	48·4	15·1	54·7	49·6	·355	4·0	0·9	82	528	110·5	47·2	—	4	1	7	19	—	8·7	22	6·22
		Sept.	29·594	0·952	68·1	37·1	31·0	63·0	47·2	15·8	53·5	47·0	·330	3·8	0·9	80	534	107·2	45·4	—	7	8	3	12	—	7·6	16	2·16

NAMES of STATIONS and OBSERVERS.	Height of S above Sea Le	Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.	Mean Degree of dity. Sat. =	Mean Weight cubic foot of A	Maximum in rays of Sun.	Millimum on Grass.	Estimated Strength.	Mean Proportion of				Mean Amount Ozone.	Mean Amount Cloud.	Number of Day it fell.	Amount col- lected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	grs.		grs.	°	°		N.	E.	S.	W.			in.	in.
BRADFORD (Yorkshire), J. McLANDBOROUGH, Esq., C.E., F.G.S.	386	July	29·730	0·604	88·3	47·2	41·1	68·5	54·3	14·2	69·8	59·8	·371	4·1	1·6	72	226	88·8	—	0·8	3	2	7	19	0·0	6·1	16	3·97
		Aug.	29·730	0·335	79·6	46·6	33·0	65·6	51·6	11·7	65·6	55·6	·340	3·9	1·1	79	227	80·0	—	0·8	6	6	6	15	0·0	7·0	25	3·75
		Sept.	29·744	0·294	67·1	43·0	24·1	60·3	46·8	11·5	53·7	48·0	·334	3·8	0·9	81	225	73·8	—	0·8	9	6	6	10	0·0	6·8	19	3·11
LEEDS (Yorkshire), The Philosophical Hall. HENRY CROWTHER, Esq.	107	July	29·774	0·910	87·0	45·0	42·0	72·6	54·1	18·5	69·0	58·7	·404	4·5	0·7	89	228	89·5	—	1·2	4	3	5	21	0·0	6·3	11	2·15
		Aug.	29·798	1·092	83·0	43·0	40·0	66·4	50·7	15·7	67·8	57·0	·358	4·3	0·9	83	230	79·6	—	1·2	5	5	5	15	0·0	6·7	23	3·71
		Sept.	29·819	0·914	71·0	42·0	29·0	61·6	48·4	13·2	54·3	50·3	·305	4·1	0·6	86	227	74·4	—	1·2	5	5	5	10	0·0	6·7	19	2·52
LANCASTER (Southfields), WILLIAM RIPPIN, Esq.	114	July	29·750	0·936	82·0	44·0	38·0	65·6	52·1	13·5	56·8	53·4	·367	4·4	0·7	85	233	—	—	—	—	—	—	—	—	—	—	—
		Aug.	29·761	1·194	79·0	43·0	36·0	66·0	50·6	15·4	57·0	54·5	·367	4·1	0·8	86	232	—	—	—	—	—	—	—	—	—	—	—
		Sept.	29·783	1·190	80·0	38·0	42·0	62·3	46·1	16·2	54·1	48·8	·333	3·9	0·8	82	227	—	—	—	—	—	—	—	—	—	—	—
COCKERMOUTH (Cumberland), H. DODGSON, Esq., M.D., F.M.S., F.R.A.S.	146	July	29·415	0·836	78·2	43·9	34·3	64·1	50·8	13·4	59·2	53·2	·351	4·3	0·8	85	227	100·3	38·1	1·2	1	1	8	22	0·0	8·3	17	3·50
		Aug.	29·397	1·336	69·9	40·4	29·5	61·6	50·4	11·4	54·8	48·9	·340	4·3	0·9	80	232	106·8	40·4	1·0	4	7	7	17	0·0	7·9	20	4·71
		Sept.	29·380	0·980	65·4	38·0	27·4	57·4	48·2	13·1	54·0	48·3	·357	4·3	0·8	87	228	103·9	43·4	0·3	10	5	9	9	0·0	7·1	9	1·04
SILLOTH, (Cumberland), "The Rectory." Rev. F. REDFORD, M.A., F.R.A.S., F.M.S.	23	July	29·834	0·907	73·0	44·0	31·0	64·8	51·9	12·9	57·3	50·4	·368	4·1	1·2	77	234	109·9	48·5	1·3	2	1	8	20	0·0	7·3	19	2·07
		Aug.	29·713	1·478	68·5	39·0	29·5	62·2	50·0	12·2	54·9	49·2	·340	3·9	0·9	85	233	107·7	46·3	1·3	3	4	9	14	0·0	7·1	21	2·92
		Sept.	29·940	0·980	66·6	38·3	28·3	61·2	47·6	13·6	53·6	48·1	·336	3·8	0·8	82	230	109·0	44·0	1·1	4	9	8	9	0·0	6·5	12	0·93
CARLISLE, Spital (Cumberland), ISAAC CARTMAN, Esq., F.M.S.	114	July	29·763	0·812	78·7	50·9	27·8	67·0	51·7	15·3	57·6	53·5	·395	4·4	1·1	83	232	100·3	46·3	1·2	1	2	8	22	0·0	8·9	17	3·50
		Aug.	29·630	1·398	75·9	37·8	37·4	65·2	48·6	16·6	55·4	51·2	·375	4·2	0·8	88	231	99·8	43·1	1·0	4	4	4	24	0·0	8·1	16	2·68
		Sept.	29·847	0·912	69·8	38·4	30·4	60·3	47·4	14·9	53·2	48·8	·344	3·9	0·7	85	228	96·6	41·2	0·5	14	5	4	11	0·0	7·4	11	1·92
BYWELL (Northumberland), Mr. W. J. TOSE, Assistant to W. B. BEAUMONT, Esq., M.P.	87	July	29·777	0·896	78·0	49·0	29·0	70·6	54·5	16·1	59·9	56·4	·454	5·0	0·8	89	229	76·4	45·7	1·0	5	0	4	22	0·0	7·0	10	2·60
		Aug.	29·718	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		Sept.	29·814	0·958	69·0	45·0	11·0	60·7	50·3	10·2	54·6	—	—	—	—	—	—	—	43·0	1·0	4	5	3	3	—	8·7	19	4·34

NAMES OF STATIONS.	Mean Pressure of dry Air reduced to the level of the Sea.
	in.
Guernsey	29·554
Truro	29·547
Plymouth	29·643
Totnes	29·717
Babbacombe	29·592
Ventnor	29·608
Eastbourne	29·448
Osborne	29·538
Southbourne	29·572
Salisbury	29·553
Barnstaple	29·544
Ramsgate	29·525
Caterham	—
Bath	29·560
Strathfield Turgiss	29·533
Marlborough	29·576
Blackheath	29·542
Whitchurch	—
Camden Square	29·550
Barnet	—
Oxford	29·546
Gloucester	29·541
Royston	29·571
Cardington	29·501
Cambridge	29·492
Stockton near Rugby	29·459
Lowestoft	29·529
Somerleyton	29·478
Wolverhampton	29·542
Leicester	29·553
Nottingham	29·521
Holkham	29·502
Llandudno	29·649
Liverpool	29·536
Bolton	29·553
Hull	29·509
Stonyhurst	29·551
Bradford	29·521
Leeds	29·464
Lancaster	29·478
Cockermouth	29·414
Silloth	29·516
Carlisle	29·504
Bywell	—

1881.

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4 days was 4°·8,
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12°·6, and 11°·9
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excess of daily
11°·1, and 10°·7
was mostly cold;
ss of temperature

The highest tempe 4°·8 below the
The lowest temper r than in 1880
The greatest daily
The least daily ra
The greatest numl
The least number
The greatest fall
The least falls of

QUART

PARALLELS OF LATITUDE, &c.	Mean Pressure of dry Air reduced to the level
	in.
Guernsey	29·
Between the latitudes 50° and 51°	29·
Between the latitudes 51° and 52°	29·
Between the latitudes 52° and 53°	29·
Between the latitudes 53° and 54°	29·
Between the latitudes 54° and 55°	29·
Mean for the Quarter, 50° to 55° Year 1878	29·
Mean for the Quarter, 50° to 55° " 1879	29·
Mean for the Quarter, 50° to 55° " 1880	29·
Mean for the Quarter, 50° to 55° " 1881	29·

5°·3 above the
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and in December

4°·5 below the
nd in December
cold in October

D

Names of Stations and Observers.	Height of Station above Sea Level.	Year 1881.	Pressure of Atmosphere in Month.		Temperature of Air in Month.						Mean Temperature.		Vapour.				Mean Reading of Thermometer.			Wind.				Amount of Ozone.	Amount of Cloud.	Rain.	
								Mean					Elastic Force.	In a cubic foot of Air.			Maximum in Rays of Sun.	Minimum on Grass.	Estimated Strength.	Relative Proportion of						Number of Days it fell.	Amount collected.
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.		Mean.	Saturation.	Mean Degree of Humidity. Sat.=100.				N.	E.	S.	W.				
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								in.
LOWESTOFT (Suffolk). S. H. Miller, Esq., F.R.A.S., F.M.S.	89	Oct.	29·898	1·743	59·7	32·3	59·4	54·5	42·4	12·1	47·6	40·4	·251	2·8	0·8	77	546	37·0	53·4	1·1	6	12	4	9	—	7·1	20	2·26
		Nov.	29·820	1·129	60·0	36·0	24·0	52·5	41·1	9·4	47·8	44·1	·291	3·3	0·1	88	544	36·9	19·0	0·8	0	2	12	16	—	6·2	11	1·26
		Dec.	29·879	1·783	51·0	27·0	24·0	43·6	34·1	8·5	39·5	36·6	·219	2·5	0·5	90	535	24·1	32·7	0·6	5	2	6	8	—	6·7	18	3·21
SOMERLEYTON (Suffolk), The Rectory, Rev. C. J. Steward, F.M.S.	50	Oct.	29·941	1·895	60·1	29·8	30·3	51·9	42·2	9·7	46·0	41·1	·229	2·6	0·6	84	548	—	—	1·1	8	12	4	7	6·7	6·4	23	2·02
		Nov.	29·888	1·434	61·0	32·0	29·0	52·9	42·2	10·7	47·1	43·6	·244	3·2	0·1	88	547	—	—	1·1	0	2	14	14	6·5	5·5	18	1·45
		Dec.	29·891	1·610	51·0	24·7	26·3	42·5	31·6	9·7	38·6	36·7	·219	2·4	0·3	91	534	—	—	1·0	2	2	16	11	5·4	7·1	19	3·49
WOLVERHAMPTON (Staffordshire), Wrottesley, E. Simpson, Esq.	500	Oct.	29·449	1·692	61·3	25·7	35·6	50·8	37·1	13·7	44·2	39·3	·241	2·8	0·1	85	542	—	—	—	7	12	3	7	—	7·7	13	2·51
		Nov.	29·504	1·528	60·2	31·2	29·0	51·9	40·0	11·9	45·7	42·9	·276	3·1	0·1	91	537	—	—	—	0	1	20	6	—	5·1	18	2·48
		Dec.	29·375	1·694	50·6	20·4	30·2	41·7	31·6	10·1	36·9	34·7	·201	2·4	0·2	92	548	—	—	—	2	3	15	11	—	8·3	15	2·58
LEICESTER (Town Museum), W. J. Harrison, Esq., F.G.S.	338	Oct.	29·755	1·761	62·3	28·5	33·8	51·9	39·6	12·3	45·1	40·6	·252	2·8	0·5	85	546	38·7	28·6	0·8	9	10	8	4	—	6·8	16	2·81
		Nov.	29·788	1·396	60·2	31·0	29·2	53·4	42·3	11·1	47·8	43·6	·284	3·2	0·5	87	540	39·2	25·6	1·0	1	2	14	13	—	5·1	19	2·12
		Dec.	29·695	1·713	52·2	21·5	30·7	42·2	32·8	9·4	38·0	35·5	·192	2·4	0·5	82	533	26·5	28·1	0·6	3	2	12	14	—	6·5	17	2·97
NOTTINGHAM (Notts), M.O. Talbotton, Esq., C.E., F.G.S., F.M.S.	185	Oct.	29·881	1·742	61·5	27·2	37·3	52·2	39·6	12·6	45·4	39·6	·241	2·8	0·7	81	547	31·9	25·1	0·4	9	12	3	7	0·1	5·7	17	3·10
		Nov.	29·650	1·398	61·8	29·5	32·3	53·1	40·7	12·4	46·9	44·8	·298	3·4	0·3	93	542	39·1	27·4	0·6	0	4	16	10	2·9	7·1	22	2·58
		Dec.	29·719	1·748	54·9	21·4	30·5	42·8	32·5	10·3	37·9	35·0	·212	2·4	0·3	91	534	31·3	29·5	0·2	4	3	12	12	1·7	7·4	26	2·50
HOLKHAM (Norfolk), John Davidson, Esq., Assistant to the Earl of Leicester.	50	Oct.	29·934	1·711	61·6	25·3	36·1	51·7	37·0	14·7	44·5	39·0	·228	2·8	0·6	81	550	33·0	30·7	2·1	8	12	3	5	—	6·6	18	2·50
		Nov.	29·842	1·486	60·6	23·7	34·9	52·8	38·4	14·4	46·3	42·1	·268	3·1	0·5	86	546	42·2	31·3	1·8	1	1	23	5	—	6·0	12	2·39
		Dec.	29·912	1·496	51·2	19·9	31·3	42·9	29·3	13·6	38·0	35·4	·206	2·4	0·3	89	538	25·8	25·1	1·1	0	2	25	6	—	6·2	12	2·42
LLANDUDNO (Carnarvonshire), James Nicol, Esq., M.D.	197	Oct.	29·784	1·820	60·0	30·6	29·4	52·2	42·6	9·6	46·9	40·5	·233	3·0	0·8	79	547	—	—	1·7	3	12	9	7	—	6·3	15	2·42
		Nov.	29·696	1·787	62·8	33·3	29·5	53·6	46·4	9·2	51·0	44·5	·291	3·3	0·9	79	538	—	—	1·5	0	1	8	21	—	6·6	16	3·06
		Dec.	29·791	1·700	56·5	30·2	26·3	47·5	38·2	9·1	43·1	39·1	·223	2·7	0·5	87	519	—	—	1·0	4	2	3	22	—	5·0	18	2·35
LIVERPOOL, The Observatory, John Hartnup, Esq., F.R.A.S.	197	Oct.	29·702	1·835	61·1	31·5	31·6	51·7	41·9	9·8	45·9	40·9	·236	2·9	0·6	83	516	—	—	—	7	14	4	6	—	6·5	12	3·00
		Nov.	29·573	1·751	56·3	33·1	23·2	51·0	43·5	9·5	47·6	45·4	·291	3·2	0·6	96	540	—	—	—	0	7	14	9	—	6·4	19	2·06
		Dec.	29·679	1·802	52·8	23·2	24·6	44·6	35·8	8·8	40·1	36·3	·215	2·5	0·5	86	550	—	—	—	4	7	16	4	—	6·5	17	3·20
BOLTON, Sharples (Lancashire), Rev. T. Mackereth, F.R.A.S., F.M.S.	500	Oct.	29·467	1·872	60·5	27·3	33·2	50·3	38·8	11·5	43·9	38·1	·230	2·6	0·6	79	543	34·3	31·8	2·2	7	11	6	7	0·3	6·4	12	4·24
		Nov.	29·262	1·759	57·7	29·1	27·6	51·3	40·4	10·9	45·6	42·1	·268	3·0	0·5	88	537	39·8	25·1	2·1	0	1	18	8	2·6	7·8	23	5·04
		Dec.	29·333	1·778	50·4	23·3	27·1	41·7	33·1	8·6	37·9	34·9	·201	2·4	0·3	89	516	41·9	27·1	1·4	5	2	11	15	2·0	7·7	23	6·44
HALIFAX, Bermerside Observatory (Yorkshire), E. J. Crossley, Esq., F.R.A.S.	530	Oct.	29·480	1·830	60·0	27·5	34·5	49·0	36·6	12·4	42·9	39·1	·229	2·8	0·4	87	543	38·6	36·1	0·8	7	12	4	8	—	6·9	15	4·52
		Nov.	29·281	1·691	59·3	30·0	29·3	51·3	41·1	9·9	45·9	42·7	·274	3·1	0·5	88	537	39·4	38·1	1·1	0	5	15	12	—	7·4	21	4·67
		Dec.	29·257	1·802	52·5	24·0	28·5	42·3	33·6	8·7	38·0	35·1	·204	2·4	0·3	90	517	39·5	31·3	0·7	5	5	9	12	—	6·9	14	4·59
HULL (Yorkshire), The People's Park, Mr. E. Peake.	12	Oct.	29·906	1·742	60·0	29·0	31·0	49·9	39·4	10·5	45·3	39·5	·250	2·8	0·6	80	550	69·8	39·3	1·5	7	12	3	7	—	4·2	20	2·86
		Nov.	29·828	1·535	60·0	30·0	30·0	51·6	40·5	11·1	46·8	42·1	·264	3·0	0·5	85	546	60·1	38·6	1·6	0	1	16	13	—	5·7	15	2·21
		Dec.	29·889	1·694	50·0	21·0	24·0	41·7	32·5	9·4	37·6	34·8	·198	2·3	0·3	88	536	46·3	39·3	1·1	4	2	16	9	—	4·5	16	2·46
STONYHURST (Lancashire), Rev. S. J. Perry, F.R.S., F.M.S., F.R.A.S.	363	Oct.	29·623	1·958	61·1	24·8	36·3	53·2	38·2	15·0	44·5	38·3	·231	2·6	0·7	78	541	95·4	37·3	—	7	11	2	8	—	6·2	12	3·37
		Nov.	29·420	1·758	60·8	30·3	30·5	53·1	42·3	10·8	47·0	43·6	·284	3·3	0·6	89	538	72·5	38·4	—	7	8	3	7	—	8·4	22	5·43
		Dec.	29·496	1·780	55·7	22·8	33·9	44·0	34·2	10·8	38·4	34·4	·203	2·3	0·4	85	519	55·3	30·4	—	4	1	13	13	—	7·5	23	4·77
BRADFORD (Yorkshire), J. McLandsborough, Esq., C.E., F.G.S.	366	Oct.	29·599	1·900	63·4	26·8	36·6	50·9	40·3	10·6	44·9	39·7	·245	2·8	0·6	83	543	65·3	—	1·2	6	12	5	8	—	6·7	22	4·26
		Nov.	29·415	1·718	58·5	29·6	28·8	52·4	42·6	9·8	47·3	42·1	·268	3·1	0·6	83	538	57·0	—	0·1	0	6	12	12	—	7·2	25	4·58
		Dec.	29·490	1·766	52·3	29·0	23·3	43·8	35·5	8·3	40·1	36·4	·215	2·5	0·5	87	517	50·3	—	1·0	1	4	9	14	—	7·8	21	3·03
LEEDS (Yorkshire), The Philosophical Hall, Henry Crowther, Esq.	157	Oct.	29·850	1·924	62·0	25·0	34·0	54·0	40·5	13·5	46·4	41·3	·260	3·0	0·6	85	547	65·1	—	1·3	8	11	4	5	—	5·8	19	2·65
		Nov.	29·663	1·694	61·0	32·0	29·0	53·0	43·0	10·0	48·3	43·7	·295	3·2	0·1	85	541	59·5	—	1·3	0	6	11	13	—	7·2	17	3·20
		Dec.	29·756	1·734	54·0	21·0	30·0	44·6	35·0	9·6	40·6	35·4	·207	2·4	0·5	82	551	47·2	—	1·3	5	3	7	16	—	6·9	17	2·15

NAMES of STATIONS and OBSERVERS.	Height of Station above Sea Level.	Year 1881.	Pressure of Atmosphere in Month.		Temperature of Air in Month.			Mean Temperature.			Mean Temperature.			Vapour.			Mean Weight of a cubic foot of Air.	Mean Reading of Thermometer.			Wind.				Mean Amount of Ozone.	Mean Amount of Cloud.	Rain.	
								Mean						In a cubic foot of Air.							Relative Proportion of							
		Months.	Mean.	Range.	Highest.	Lowest.	Range.	Of all Highest.	Of all Lowest.	Daily Range.	Air.	Dew Point.	Elastic Force.	Mean.	Short of Saturation.	Mean Degree of Humidity. Sat. = 100.		Maximum in Rays of Sun.	Minimum on Grass.	Estimated Strength.	N.	E.	S.	W.			Number of Days it fell.	Amount collected.
	feet.		in.	in.	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°								in.	
LANCASTER (Southfields), WILLIAM ROTER, Esq.	114	Oct.	29·874	1·884	68·0	25·0	38·0	52·1	39·0	13·1	44·7	39·7	·244	2·8	0·5	85	510	—	—	—	—	—	—	—	—	—	18	2·59
		Nov.	29·643	1·750	57·0	28·0	34·0	52·2	41·2	11·0	46·7	40·8	·257	3·0	0·7	81	342	—	—	—	—	—	—	—	—	—	21	5·73
		Dec.	29·725	1·430	52·0	23·0	29·0	45·4	34·7	8·7	39·3	35·1	·196	2·3	0·4	81	355	—	—	—	—	—	—	—	—	—	21	4·68
COCKERMOUTH (Cumberland), H. DODGSON, Esq., M.D., F.M.S., F.R.A.S.	146	Oct.	29·850	2·041	66·8	21·7	45·1	52·4	38·1	14·3	44·6	37·8	·228	2·6	0·7	77	548	48·4	32·1	0·8	7	13	4	7	1·8	5·5	10	2·33
		Nov.	29·546	1·986	62·9	28·2	34·7	52·2	43·5	8·7	47·9	42·7	·273	3·1	0·7	84	539	70·4	36·2	1·0	0	4	11	15	2·5	7·7	24	6·14
		Dec.	29·625	1·742	53·0	19·9	33·1	43·7	35·0	8·7	39·5	35·5	·209	2·4	0·4	87	552	49·9	29·1	0·8	5	4	10	12	2·0	6·9	17	3·84
SILLOTH (Cumberland), "The Rectory," REV. F. REDFORD, M.A., F.R.A.S., F.M.S.	28	Oct.	29·783	2·063	65·0	21·0	44·0	51·9	38·4	13·5	44·4	38·4	·232	2·7	0·7	78	551	97·8	31·0	1·5	6	11	5	5	3·3	5·4	11	2·18
		Nov.	29·601	1·965	59·4	28·0	31·4	51·5	42·0	9·5	46·8	43·0	·277	3·1	0·5	87	548	77·8	29·4	2·0	0	5	10	15	10·7	6·3	21	5·13
		Dec.	29·781	1·806	52·8	20·2	32·6	43·1	34·7	8·3	39·1	36·1	·215	2·5	0·3	90	554	64·1	31·1	1·5	6	6	6	13	8·2	5·9	13	2·15
CARLISLE, Spital (Cumberland), ISAAC CARTMELL, Esq., F.M.S.	11	Oct.	29·889	2·042	68·8	17·7	51·1	52·8	37·5	15·3	44·1	39·1	·238	2·8	0·5	82	549	78·3	31·5	1·1	3	14	4	10	3·3	6·0	9	1·70
		Nov.	29·579	1·765	60·7	23·4	35·3	52·6	40·1	12·5	46·8	42·8	·275	3·1	0·6	84	541	68·4	31·3	1·4	0	12	7	11	4·8	7·2	17	3·33
		Dec.	29·767	1·756	52·8	18·0	34·8	43·8	31·1	10·7	38·8	35·6	·209	2·4	0·4	89	552	53·6	27·0	1·1	1	9	8	13	4·2	7·5	18	2·45
BYWELL (Northumberland), MR. W. J. TONE, Assistant to W. H. BEAUMONT, Esq., J.P.	87	Oct.	29·748	1·858	63·0	28·0	35·0	57·8	39·4	18·4	47·6	43·8	·296	3·3	0·5	87	543	—	32·2	1·7	11	8	5	7	—	8·6	11	3·39
		Nov.	29·578	2·010	61·0	32·0	29·0	56·4	42·4	14·0	48·6	44·6	·306	3·4	0·4	90	519	57·9	36·6	1·3	0	2	8	20	—	8·5	9	1·62
		Dec.																										

Second [illegible] *are placed*—

At Guernsey, at the height of 12 feet *above the ground*; the amount collected was 2·91 inches.
" Oxford, " 22 " " " 1·71 " " 2·76 " " 2·28 " " 7·75 "
" Carlton-on, " 36 " " " 2·04 " " 2·68 " " 3·01 " " 7·11 "
" Nottingham, " 59 " " " 2·79 " " 2·18 " " 2·19 " " 7·16 "
" Hoxham, " 4 " " " 2·56 " " 2·06 " " 1·99 " " 6·53 "

Oct. Nov. Dec. Total in Quarter.
13·41 inches.

Fog—continued.

In November, on the 1st at Totnes and Torquay; on the 2nd at Torquay, Strathfield Turgiss, Barnet, and Oxford; on the 3rd at Torquay, Strathfield Turgiss, Cardington, and Cambridge; on the 4th at Torquay and Strathfield Turgiss; on the 6th at Guernsey, Truro, Strathfield Turgiss, and Bolton; on the 7th at Carlisle; on the 8th at Truro, Totnes, Torquay, Ventnor, Osborne, Strathfield Turgiss, Barnet, Oxford, Rugby, Leicester, Wolverhampton, Bolton, and Halifax; on the 9th at Totnes, Torquay, Strathfield Turgiss, and Halifax; on the 10th at Totnes; on the 13th at Torquay; on the 14th at Barnet, Rugby, Cambridge, and Wrottesley; on the 18th at Strathfield Turgiss, Barnet, Oxford, Cambridge, and Leicester; on the 20th at Wrottesley; on the 25th at Leicester; on the 28th at Totnes; and on the 29th at Totnes, Strathfield Turgiss, Barnet, Oxford, Cambridge, and Leicester. Fog in November has least prevailed at the stations between latitude 51° and 52° and most prevailed at extreme southern stations and those between latitudes 53° and 55°.

In December, on the 1st at Hull and Bywell; on the 6th at Oxford, Cambridge, Wrottesley; on the 8th at Marlborough and Bolton; on the 9th at Whi[illegible] Blackheath, Oxford, Royston, Cambridge, Rugby, Bolton, Halifax, and Hull; on the 10th at Marlborough, Oxford, Cardington, Rugby, Cambridge, and Wrottesley; on the 11th at Plymouth, Oxford, Cardington, Rugby, Cambridge, and Wrottesley; on the 13th at Blackheath, Oxford, Cardington, Rugby, Cambridge, Wrottesley, and Bolton; on the 14th at Oxford, Cambridge, and Wrottesley; on the 15th at Cardington, Wrottesley, and Halifax: on the 16th at Oxford, Cambridge, and Wrottesley; on the 22nd at Strathfield Turgiss, Oxford, Cambridge, Wrottesley, and Bywell; on the 23rd at Marlborough, Oxford, Cardington, Rugby, Wrottesley, Bolton, and Halifax; on the 26th at Truro, Torquay, and Bolton; on the 27th at Rugby and Bolton; on the 28th at Truro, Cardington, Rugby, Cambridge, Bolton, and Hull; on the 30th at Truro; and on the 31st at Torquay, Cardington, Cambridge, and Wrottesley. It will be seen that on the south of England there was no fog till towards the end of the month, and that the stations in the Midland Counties were the [illegible]y foggy.

NAMES OF STATIONS.	Mean Pressure of dry Air reduced to the level of the Sea.	Highest Reading of the Thermometer.	Lowest Reading of the Thermometer.	Range of Temperature in the Quarter.	Mean of all Highest.	Mean of all Lowest.	Mean Monthly Range of Temperature.	Mean Daily Range of Temperature.	Mean Temperature of the Air.	Mean Temperature of the Dew Point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Mean additional Weight required for saturation.	Mean degree of Humidity.	Mean Weight of a cubic foot of Air.	Mean Reading of Maximum in Rays of Sun.	Mean Reading of Minimum on Grass.	Mean Estimated Strength.	Wind. Relative Proportion of N.	E.	S.	W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Number of Days on which it fell.	Amount collected.
	in.	°	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in.
Guernsey	29·705	61·0	33·5	28·5	52·9	44·7	23·9	8·3	48·3	45·0	·301	3·4	0·4	89	542	83·3	39·6	1·3	4	8	10	9	4·8	6·0	63	12·63
Truro	29·676	65·0	24·0	42·0	55·1	41·9	34·7	15·2	48·3	43·0	·280	3·2	0·7	82	545	—	—	2·4	5	7	8	11	—	6·8	59	13·29
Plymouth	29·758	62·6	28·7	33·9	53·5	42·6	29·7	10·9	47·8	43·7	·287	3·3	0·5	89	547	—	—	1·5	5	8	10	8	—	6·5	58	10·22
Totnes	—	65·8	20·9	44·9	51·2	39·7	37·5	14·4	46·7	42·6	·276	3·1	0·6	88	547	87·6	34·7	1·8	4	7	9	12	—	6·4	54	18·66
Babbacombe	29·707	65·5	29·0	36·3	52·6	42·2	28·3	10·4	47·3	42·3	·274	3·1	0·6	84	542	92·9	34·0	1·7	4	8	9	11	4·4	6·7	54	13·76
Ventnor	29·791	61·9	34·9	23·0	52·6	44·0	25·5	8·6	47·4	43·7	·287	3·2	0·5	86	546	—	—	1·0	5	10	8	7	6·3	6·6	44	10·15
Osborne	29·629	59·3	28·1	31·2	51·6	41·1	30·3	10·5	44·1	41·9	·272	3·2	0·4	87	516	80·3	34·5	0·5	6	4	12	9	—	5·2	44	9·20
Brighton	29·760	60·5	24·4	31·9	49·0	40·9	25·9	9·1	45·4	41·0	·258	3·0	0·5	84	546	—	37·0	1·2	6	7	7	11	—	7·0	43	8·37
Southbourne	29·716	62·0	26·0	36·0	52·0	41·7	29·4	10·3	46·9	41·9	·269	3·1	0·7	83	546	—	—	1·5	6	6	7	11	—	5·7	39	9·25
Salisbury	29·725	63·5	19·0	44·5	52·9	35·2	41·0	17·7	44·1	40·6	·255	2·9	0·4	86	548	74·5	31·6	1·3	5	6	8	11	—	6·7	54	9·95
Barnstaple	29·672	65·0	26·5	34·5	53·8	43·1	32·5	10·6	48·2	44·0	·291	3·3	0·6	85	545	—	—	1·2	4	6	11	10	—	4·8	55	15·01
Strathfield Turgiss	29·741	63·2	19·8	43·4	51·0	37·1	37·4	13·9	44·4	40·8	·257	3·0	0·4	87	547	77·4	31·6	1·2	4	8	9	10	1·4	6·1	44	7·44
Bath	29·715	59·6	25·4	31·2	49·7	38·5	34·2	13·6	43·7	40·9	·255	3·0	0·4	89	539	89·9	35·8	1·5	9	6	10	9	—	5·8	55	13·17
Marlborough	29·720	63·3	31·8	39·0	49·5	37·6	32·5	11·7	43·6	39·8	·248	2·8	0·4	88	543	76·9	32·0	1·0	4	6	11	9	—	6·5	49	8·60
Blackheath	29·734	62·5	24·0	38·5	48·9	39·0	30·8	9·9	44·5	41·2	·262	3·0	0·4	89	548	74·7	34·3	1·1	4	6	9	12	—	6·7	41	8·15
Whitechurch	29·736	62·2	22·0	40·2	49·5	36·8	34·4	12·8	43·3	40·3	·252	2·9	0·4	91	549	—	—	1·2	5	8	9	8	—	6·8	49	9·05
Camden Square	29·735	61·4	27·8	36·1	50·5	39·3	30·7	11·2	44·9	40·4	·253	2·9	0·6	85	548	68·9	34·3	—	7	7	7	10	—	6·6	44	8·12
Barnet	29·657	63·8	20·2	43·6	49·2	36·0	35·9	13·2	43·2	39·7	·240	2·8	0·4	88	545	74·5	34·8	—	5	7	7	11	—	6·7	43	8·25
Oxford	29·712	63·4	21·4	42·0	50·9	39·6	32·1	11·3	44·4	41·2	·261	3·0	0·4	89	546	81·5	35·6	3·6	4	7	11	8	0·6	6·2	48	7·99
Gloucester	29·716	63·5	29·5	45·0	51·0	36·0	33·8	12·1	44·6	41·5	·264	3·0	0·4	89	550	65·9	35·2	0·7	5	6	6	14	—	5·2	55	7·48
Royston	29·788	65·0	25·2	39·8	49·5	36·0	34·1	11·4	43·4	39·6	·245	2·8	0·5	87	547	—	—	—	4	5	12	10	—	5·9	44	7·31
Bedford	29·722	62·6	19·6	43·0	49·4	37·3	34·3	12·1	43·5	40·0	·250	2·9	0·4	87	549	84·4	31·5	1·6	4	6	8	13	—	6·1	—	7·46
Cambridge	29·695	64·6	21·5	43·1	50·5	36·3	35·6	12·2	44·4	40·1	·250	2·8	0·5	85	550	77·8	31·6	1·1	4	6	13	7	—	6·1	52	7·32
Rugby	29·668	67·0	15·0	52·0	49·9	35·7	36·8	14·6	42·7	39·6	·247	2·8	0·4	89	545	—	—	0·5	3	7	12	8	0·5	6·8	46	7·61
Somerleyton	29·709	61·0	22·7	38·3	49·4	39·3	29·2	10·0	47·9	40·2	·251	2·9	0·4	88	550	—	—	1·1	4	5	11	11	0·2	6·4	60	7·56
Wolverhampton	29·690	61·3	20·4	40·9	48·1	36·2	31·6	11·9	41·9	39·0	·239	2·8	0·3	89	542	—	—	1·3	6	6	13	8	—	7·0	44	7·28
Leicester	29·690	62·3	21·5	40·8	49·2	38·2	31·9	10·9	43·6	39·2	·241	2·8	0·5	85	546	73·8	30·8	0·8	4	5	11	10	—	6·1	52	7·90
Nottingham	29·675	64·5	21·4	43·1	49·4	37·6	33·4	11·8	43·4	40·1	·251	2·9	0·4	85	548	69·9	34·7	0·4	4	6	10	10	1·7	6·7	65	8·18
Holkham	29·709	61·6	19·9	41·7	49·2	35·2	34·1	14·0	42·9	38·8	·235	2·8	0·5	86	551	60·5	28·1	1·8	3	5	17	5	—	6·3	42	7·22
	29·739	62·8	30·2	32·6	51·7	42·4	27·7	9·3	47·0	41·0	·250	3·0	0·7	80	545	—	—	1·4	2	5	7	17	—	6·5	47	8·05
	29·646	61·1	28·2	34·9	49·8	40·4	27·1	9·4	44·6	40·2	·251	2·9	0·6	85	545	—	—	1·4	3	9	11	6	—	6·5	48	8·43
	29·682	60·5	23·3	37·2	47·8	37·4	29·3	10·3	42·5	38·4	·234	2·7	0·5	85	542	51·3	30·7	1·5	4	6	12	9	2·6	7·5	58	16·32
	29·726	60·0	24·0	36·0	47·5	37·5	27·4	10·3	42·3	38·0	·229	2·8	0·4	88	542	69·3	35·2	0·2	4	7	9	11	—	7·1	50	13·78
	29·675	60·0	24·0	36·0	47·7	37·4	29·0	10·2	43·2	38·9	·239	2·7	0·5	84	551	58·7	30·0	1·5	1	5	12	10	—	6·8	51	7·51
	29·689	61·1	22·8	38·3	50·1	37·9	31·6	12·5	45·3	38·8	·229	2·7	0·6	84	544	71·4	34·7	—	6	8	9	—	—	7·4	57	14·57
	29·664	63·4	26·0	37·4	49·0	39·6	30·4	9·6	44·1	39·4	·241	2·8	0·4	84	545	67·5	—	1·1	3	7	9	11	—	7·5	68	11·87
	29·651	62·0	21·0	41·0	50·5	39·5	31·0	11·0	45·1	40·1	·251	2·9	0·5	83	546	53·3	—	1·5	4	8	7	11	—	6·0	54	8·10
	29·679	63·0	23·0	40·0	49·2	38·3	33·7	10·9	43·6	38·5	·230	2·7	0·5	83	549	—	—	—	—	—	—	—	—	—	55	13·00
	29·622	60·8	19·9	40·9	49·4	38·5	37·6	10·6	44·0	38·7	·237	2·7	0·6	83	546	69·6	32·3	0·5	4	7	8	11	1·9	6·7	51	12·33
	29·693	64·0	21·2	44·8	48·8	38·4	32·0	10·4	43·4	39·2	·241	2·8	0·5	85	551	72·9	34·9	1·1	4	9	6	11	9·1	5·9	45	9·66
	29·610	65·8	17·7	51·1	49·7	36·9	40·4	13·8	43·2	39·2	·241	2·8	0·5	85	547	65·4	30·6	1·2	1	12	6	11	4·1	6·9	44	7·65

Mean Temperature. most frequent

Month. D. h.

The highest temperatures of the air were at Carlisle, 68°·8; Rugby, 67°·0; and Cockermouth, 66°·8.
The lowest temperatures of the air were at Rugby, 15°·0; Carlisle, 17°·7; and Salisbury, 19°·0.
The greatest daily ranges of temperatures were at Salisbury, 17°·7; Totnes, 14°·4; and Rugby, 14°·3.
The least daily ranges of temperatures were at Guernsey, 8°·3; Ventnor, 8°·6; and Brighton, 9°·1.
The greatest number of days of rain were at Bradford, 68; at Nottingham, 65; at Guernsey, 63.
The least number of days of rain were at Gloucester, 35; at Southborne, 39; at Holkham, 42.
The greatest falls of rain were at Totnes, 18·40 inches; Bolton, 16·32 inches; and Halifax, 13·78 inches.
The least falls of rain in the quarter were at Holkham, 7·22 inches; at Cambridge, 7·32 inches; and Strathfield Turgess, 7·44 inches.

Quarterly Meteorological Table for different Parallels of Latitude.

PARALLELS OF LATITUDE, &c.	Mean Pressure of dry Air reduced to the level of the Sea.	Mean of all Highest Readings of the Thermometer.	Mean of all Lowest Readings of the Thermometer.	Mean Range of Temperature in the Quarter.	Mean of all Highest.	Mean of all Lowest.	Mean Monthly Range of Temperature.	Mean Daily Range of Temperature.	Mean Temperature of the Air.	Mean Temperature of the Dew Point.	Mean Elastic Force of Vapour.	Mean Weight of Vapour in a cubic foot of Air.	Mean additional Weight required for saturation.	Mean degree of Humidity.	Mean Weight of a cubic foot of Air.	Mean Reading of Maximum in Rays of Sun.	Mean Reading of Minimum on Grass.	Mean Estimated Strength.	Wind. Relative Proportion of N.	E.	S.	W.	Mean Amount of Ozone.	Mean Amount of Cloud.	Rain. Mean Number of Days it fell.	Mean Amount collected.
	in.	°	°	°	°	°	°	°	°	°	in.	grs.	gr.		grs.	°	°									in.
Guernsey	29·705	62·0	33·5	28·5	52·9	44·7	23·9	8·3	48·3	45·0	·301	3·4	0·4	89	542	83·3	39·6	1·3	4	8	10	9	4·8	6·0	63	12·63
Between the latitudes 50° and 51°	29·733	63·6	29·2	35·7	52·6	41·8	30·2	10·9	47·0	42·5	·288	3·2	0·6	85	546	86·0	35·1	1·7	5	7	9	11	5·4	6·8	56	11·56
Between the latitudes 51° and 52°	29·714	62·8	22·5	43·1	49·7	38·8	34·2	12·3	44·4	40·9	·259	2·9	0·4	89	546	75·8	33·9	1·4	5	7	9	11	0·9	6·5	48	9·11
Between the latitudes 52° and 53°	29·675	63·3	20·8	42·5	49·2	37·8	33·6	12·1	43·3	39·7	·246	2·9	0·4	87	548	67·8	31·4	1·0	4	5	12	9	4·8	6·4	51	7·35
Between the latitudes 53° and 54°	29·688	61·6	25·3	37·6	49·3	38·9	29·5	10·3	44·0	39·5	·243	2·8	0·5	84	545	61·7	34·2	1·4	3	7	10	11	2·6	6·6	54	10·9
Between the latitudes 54° and 55°	29·619	65·9	20·2	45·7	49·3	38·1	36·9	11·2	43·6	38·9	·232	2·8	0·5	84	548	71·2	32·7	1·3	3	9	7	11	5·0	6·3	45	10·12
Mean for the Quarter, 50° to 55°: Year 1878	29·513	70·0	12·9	57·1	46·7	35·5	33·9	11·2	40·9	36·7	·227	2·6	0·5	86	547	66·9	30·6	1·1	9	5	6	10	3·8	9·4	49	9·23
" 1879	29·987	65·2	12·1	53·1	46·8	35·0	36·0	11·8	40·7	37·0	·224	2·6	0·4	86	550	66·4	30·6	1·0	9	8	5	9	3·2	6·6	35	4·23
" 1880	29·648	64·5	21·3	43·3	49·3	38·0	34·1	12·4	43·9	39·1	·241	2·8	0·5	86	548	68·9	33·1	1·3	7	6	6	12	2·4	6·6	50	12·53
" 1881	29·685	63·4	23·6	40·9	50·0	38·9	32·9	11·4	44·5	40·3	·255	2·9	0·5	86	547	72·3	33·5	1·4	4	7	9	11	3·7	6·4	50	9·9

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